WORK STUDY BULLETIN NO. 1

Department of Agricultural Engineering
The University of Alberta
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A L B E R T A N

DAIRY ROUTINE TIME STUDY DATA

by

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November 1969

CONTENTS

DAIRY ROUTINES : WORK STUDY

This bulletin describes the place of Work Study in Dairy Routines. It outlines the recent research work done, and publications, both in Alberta and in other parts of the world. Dairying is a highly repetitive task which lends itself to the full use of the techniques of Work Study and particularly Time Study. Dairying is probably the most similar farm task to industrial manufacturing, in which Work Study has been so successful in stimulating increased productivity. Labour productivity in milking routines is likely to become of increasing importance as wages and standards of living of agricultural workers rise.

In Ontario 22% of the cost of Milk Production is labour (1). This can probably be reduced to 5% within a century. This at least, should be regarded as a target. The use of the milking machine and the possibility of automating a number of tasks, traditionally done manually with simple tools, heralds a new era in dairy farm work, 250 cows per man hour. To emphasize the computer age, three examples of how electronic digital computers may be used for dairy work, are included as an appendix.

(1) Dairy Enterprise Data. Canadian Farm Digest, Vol 6. No.1. Dec.1967.

This bulletin replaces the previous 1962 publication of the Department of Agricultural Engineering, University of Alberta. This contained details of Time Standards obtained in 1962 by analysing motion picture photographs of the operations of a number of dairy farms in the milk shed around Edmonton. In the course of the six months in the Fall of 1966, Mr. M.S. Rowlands, who is qualified both in Dairying and Work Study, repeated these investigations, using stop-watch/time-study and other means of analysing the performance of dairy parlours. He confined his studies to the detailed observation of six farms. Data which is contained in Appendix 1 is in a similar format, for ease of comparison, with date produced by several of the international organisations* concerned with providing time standards with which dairy farmers can compare their performance so as to identify those aspects of their work routine which are occupying more time than the best farmers.

The physical arrangements of the milking facilities may vary from herringbone parlours to stalls with one or two levels; one or two sides to the parlour or the barn. This all seriously affects the obtainable potential milk output per hour of labour input.

*Congress Internationale du Genie Rurale (CIGR V); Congress Internationale Organization Scientifique de Travail in Agriculture (CIOSTA); United Kingdom Milk Marketing Board (UKMMB); Organization for Economic Co-operation & Development (OECD).

Until a few years ago, several alternative parlour designs appeared to be equally attractive. It is now becoming much more clear that herringbone parlours, on two levels, OR with preparation stall and milking stall with automated washing and herding, produce better results than any of the alternatives so far popularly adopted on a large scale.

Clough & Quick (12) reported in 1967 that in five unit, ten stall herringbone parlours, in which the stalls were at an angle of 30° to 35° to the pit, WALKING distance between udders is reduced by 3-ft. The parlour can be contained under a span 75-ft long and 22.5-ft wide. This had a potential of up to 68 cows milked per man hour.

The Rototandem described by Ekman (13), will enable a man to produce at the rate of 125 to 175 cows per hour. This is suitable for herds of 300 to 800 cows.

In both cases the actual amount of time depends upon the extent of automation of washing and floor washing. In the Rototandem, this can be carried out in 25 minutes if floor and unit cleaning is semi-automatic. The Rotolactor 18, with calving section and offices and changing rooms, requires a building 135-ft x 60-ft, which is the diameter of the Rotolactor.

One of the advantages of the Rotolactor is that the sound of the engine house is inaudible in the milking area. Noise affects speed of milking of both the operator and cow. This points up the fact that the attitude of the operators must be changed from

traditional practices to make the fullest use of mechanized milking methods' potential. This is discussed below.

METHOD STUDY DEVELOPMENT: It is notable that the benefits of the two level milking parlours were first discussed by Morris W.H.M. and Vestergaard, E.C. (8). The laborious business of stooping and bending in parlours without a pit, incurred quite unnecessary and unproductive work, which unduly tired the milker and served no useful purpose. This is mentioned to illustrate the earlier and now well-known benefits, derived from Work Study. Similar developments of this type would include the heating of the pit by soil heating cables in the pit wall and overhead infra-red heating lamps, to provide localized warmth and ensure that the energies of the milker were not dissipated keeping himself warm. This activity never produced a single drop of milk. The object in milking is to produce milk with a minimum amount of time and labour and with the greatest economy of conversion of "food:milk" through the rumen of a dairy cow.

FACTORS INFLUENCING PRODUCTIVITY: Let us consider, individually, the twelve main aspects of dairy husbandry which will influence thru-put, cows per hour. These are :-

1. Feeding Policy;
2. Rate of Let-down;
3. Hygiene;
4. Vacuum Pressures;
5. Noise;
6. Herding;
7. Gate Mechanism;
8. Parlour Design;
9. Herd Uniformity in Relation to Batch Size;
10. Operator Pace & Skill.
11. Recording Policy;
12. Incentives.

Feeding Policy: For maximum rate of milking, the feeding policy must be such that the feed can be consumed and metered in the time required for milking. In herds where there are no preparation stalls, the amount of time available is less than those parlours in which cows are washed and milked in the same stall and can be fed while they are awaiting either of these. The rate of feeding will depend on the palatability of the ration and the degree of hunger.

Rate of Let-down: The rate af which cows can be milked varies from cow to cow and is probably also related to the amount of the milk yield. It is also related to the condition of the machines and the adjustment of vacuum pressures. On a number of farms it has been observed that this is not checked with sufficient regularity to ensure that the bad habits of slow milking are not created by failure to adjust vacuum pressures and liners correctly.

Hygiene: The use of paper towels which are disposable, can substantially contribute to increases in the thru-put of the parlour. A cloth, which has to be laundered and wrung out before and after use and deposited in a dirty or clean pail, will increase the time required. Hot towels or water will allow for better stimulation of milk production, for it is necessary that the cow should be washed approximately three-quarters of a minute before milking is commenced. This stimulation is both physiological and psychological and should be regarded as a focus of management attention when checking on the actual routine used by operators.

Vacuum Pressures: The correct vacuum pressuresvaries between machines. Some machines can be adjusted so that the massage pressure varies in the cycle in relation to the milk suction pressure. In other machines, these two are kept in a constant ratio. The correct number of pulsations recommended by some authorities is about 48 per minute, and a pulse ratio of 2 for 1.

Noise: Noise is important both to the operator and the cows. It has been mentioned in the latter, that the speed of milking is related to the noise. Some farmers are reluctant to allow any strange noises to occur and the cows become exceedingly agitated when any strange noise occurs. On the other hand, other farmers are unconcerned about this and their cows can tolerate considerable noise. Some farmers believe that music helps. The main point would appear to be that having set on a policy, it is best to stay with it.

Herding: The arrangements of the collecting yard and the means by which cows are selected for milking will influence the time required per cow. A useful aid to herding is an electric dog, which is an electrified fence which is drawn forward by means of ropes and pulleys. It is usually placed in the collecting yard to keep the cows close to the parlour entry. It is possibly part of a gate mechanism. Cows will normally select their own "pecking order". although this may not be the best order for quick milking. It is better to have batches of cows entering the parlour so that they make full use of the equipment and time available. One very slow milker amongst a group of fast milkers may cause considerable reduction in the thru-put.

Other mechanized gates, are alternatives to electric dogs, such as a solid tubular gate which is winched forward from a control in the parlour, will reduce the necessity to go out into the yard and select cows. Several other such mechanisms can be used to divide the herd up into the groups suitable for ease of milking.

Gate Mechanisms: The arrangement of the gate controls in the parlour, their convenience for opening and closing, and the room allowed for the cows to turn, is a matter of considerable skilled design. Most of the manufacturers know the correct dimensions for cows of various breeds. Electric motors can speed up the time needed of the operator.

Herd Uniformity to Batch Sizes: As with any mass production process, it is easier to control production where the standard homogenous product is required. Herds with large numbers of 'special' cows requiring 'special' treatment will slow down production. It should be noted that temperamental cows often occur in herds where silence is given undue precedence. The herd should be divided into batches which are treated in the same identical way.

Operator's Pace & Skill: Just as the athletic ability of individuals varies, so does the rate at which people can and do work. There are ace operators and there are people who are of sub-average slowness. The times given in the tables of Time Study data, relating to dairy work, are intended to be an assessment of the average time for an average worker, working at average pace. Some workers have double this skill and work at double the pace, whereas the reverse situation can apply. Some workers prefer to rest occasionally during the

process and others prefer to work without stop, taking rest after the end of their work. These individual preferences vary and there is no special merit in recommending one over the other.

As was mentioned earlier, the attitude of workers is most important in deciding upon the physical arrangement of the milking arrangements. This is regarded by the consultant branch of Surge, who do not rely to any great extent on Time Study date, preferring to rely on their experience of the performance likely to be obtained according to their assessment of the type of husbandry, milking practice and operator skill to be employed.

Although financial reward is far down the list of important aspects leading to job satisfaction, the way in which workers are paid will influence their attitude to their work. Bonus schemes, by which the pay cheques reflect the diligence of the worker, are the best way of ensuring a fast pace of working and contented, reliable employees. High wages are no substitute for the credit of acknowledging a job well done, of acknowledging a contribution towards a successful, well-conducted business or indications of long-term stability of employment and increasing prosperity. Management must provide clear instructions of the requirements, as visualized by them, of the worker. There are any different ways of milking, only one of which is the one required by the employer. The employer must ensure that his requirements are fully understood by all workers.

Incentives: It is notable that in Industry, as much as one third increase in pace and output can be obtained by offering incentive schemes. It has been noted in Alberta that a number of successful incentive schemes for dairy workers have been instituted which have been beneficial to all parties. A herdsman with a bonus scheme which reflects the skill he uses to maintain milk yield and economize with feed, can result in considerably increased productivity and doubled wages. The worker will work at a brisk pace, because his payment depends on doing the job, rather than attending for overtime and hours.

Recording Policy: In some herds daily records are kept of milk yield and in others, no records at all. It must be recognized that recording takes time and depends on the writing skills of the operator and the convenience of forms and meters. Much of this can be automated but is uneconomical except for herds of very large size. Dependent upon the type of records and the facilities provided and the frequency of making the records, so will the overall time per gallon of milk be increased or decreased.

Labour Cost per Gallon: In order to provide simple means of calculating the independent effects of wages, milking time, feeding policy, equipment layout, and milking routine method, the author has devised a slide rule and graph from which approximate calculations can be made quite easily. Three copies of this are included in this bulletin to allow readers to construct the slide rule, at their leisure. Instructions for this are given in the last appendix and instructions for the use of the slide rule are contained in the second to last (penultimate) appendix.

The Graph: The graph contains a means of deciding which will take the longer, the cow eating or the cow being milked. For "which ever is the longer", will be the time required and taken by the cow in the stall. This will be a controlling factor determining the ratio between the milking machine units and the stalls. The number of cows per 100 minutes milking period and the approximate pounds of milk produced per milking can be calculated for the number of milking machines available per man. The method of using the graph, which relies on the use of straight lines or a transparent ruler only, and no calculation, is described in Appendix 1 which, with the graph is on pages supplied separately

It will be noted that the time required for feeding, varies according to the type of food provided. High moisture grain takes less time per pound to be eaten than cubes: Cubes themselves, take less time than meal. The graph has assumed that 3.5-lb. of feed are needed for every gallon of milk produced and that other diet will provide for maintenance. In many dairies, this is not the accepted feeding policy. At times, concentrates are only fed for production over the first 10-lb. produced. This matter is one of nutrition farm policy and is outside the scope of Time Study, which is concerned only with the time required for feeding.

The table at the left of the graph has provision for one man using between 3 and 8 units. This upper ceiling will be beyond the realms of possibility, even with the most agile and speedy worker on the lower yielding herds, until they are more highly automated.

Time Study data can be used to assess the number of minutes per cow required and to ensure that the man has time to perform the manual work for all the machines he is using within the feeding or milking time, for the fastest animal in the herd. It should be noted that the sum total of the times required may not be the exact total time required. For, if two jobs require to be done simultaneously, they may get out of phase. Or, the opportunity to do a task may not occur just exactly at the end of the previous task.

There are a variety of "queuing" problems and waiting problems associated with 'batch' milking. Normally the cows giving the highest yields are the first into the stalls and the low yielders, about to be dried-off, are the last in. There are usually considerable variations between the milking time of individual cows in the herd. This being a function of the physical properties of the mammery tissues and the orifice in the teat. There is a well-known engineering law, known as Bernouli's Law, which states that the rate of flow is related to the size of the orifice and the differential in pressure across it. However, for practical purposes, it is possible to predict what the theoretical milking time should be according to the figures produced by Clough & Dodd (1) which is quoted in Bulletin 177.

<u>THIS IS THAT THE MILKING TIME IS EQUAL TO 2-1/2 MINUTES PLUS 1/6th OF A MINUTE FOR EVERY GALLON OF MILK PRODUCED</u>.

There is, in contrast, a school of thought, highly regarded in W. Germany, that some cows take 5 minutes regardless of their yield, and others take 8 minutes, and so on.

Whichever law governs theoretical milking time, milkers are asked to perform an almost impossible mental feat. This is to keep 3 to 6 hour-glass records of the theoretical milking times of each cow and to assess exactly when each is due to have the milking machine removed. It is regarded as bad dairy husbandry to leave a milking machine on a cow after the milk flow has ceased. It needs little imagination to see that such a procedure involving a vacuum pump, can be damaging physiologically and psychologically, as well as being painful. One possibility is to include a photo-electric sensing device in the milking machine milk line, which will switch off the vacuum as soon as milk flow ceases. Another, which is described in a separate paper, available from the Department of Agricultural Engineering, University of Alberta, discusses the possibility of a simple real time analog computer which can be attached to, or adapted for, any type of milk recording device. This provides the milker with a warning of a flashing light or a bell note, whenever a cow has exceeded the theoretical time required for the amount of milk she has just given.

Many research workers believe that the bad habit of slow let-down and wasted labour in a milking parlour can be acquired by cows if they are allowed to prolong either their eating or to constrict their "sphinctor" muscle and reduce the milk flow. Whereas such bad habits may be acquired by bad milking practices, there is also the well accepted fact that hereditary characteristics of slow speed of milking can be bred into or out of a herd.

COMPUTERS FOR DAIRY WORK MEASUREMENT

The three problems of computation which exist in the application of Work Measurement Techniques to Dairies, can be termed:-

1. Avoiding over-milking.
2. Performance Analysis.
3. The selection of correct numbers of machines: stalls; cows to workers.

The first is that of the milker who is required to assess the theoretical milking time for each cow and relate this to the actual milking time. For each milking machine he starts what amounts to a mental hour-glass which he checks from time to time to see whether or not milking time has elapsed and the plastic tube conveying the milk is empty and clear.

The second computation is that of the Time Study Observer who may be required to watch a milking performance and to compare the actual productivity and times with that of theoretical standards in order to identify those areas in which the milker departs from normal accepted time standards. If these are identified accurately, those parts of the routine which are taking too long, can be subjected to Method Study and the worker informed, so that his output is increased.

The third, is the problem of the mixture of high yielders/ low yielders, fast milkers & slow milkers, within the queue of cows entering the parlour and the effect these have on the phasing of the milkers' work so that he does not slow down his output because there are several jobs waiting for his completion at one moment and no jobs for him to do at another.

All three computations are highly repetitive and lend themselves to computation methods using electronic devices.

1. OVERMILKING:

A Real Time Analog Computer capable of contrasting actual elapsed milking time with theoretical milking time has already been mentioned. The theory time is computed to the formula 2.4 minutes plus 1/6th of a minute per pound of milk. The device is two dials, face to face, one measuring elapsed time and the other weight of milk produced. A "Milkometer", measures each quarter pound of milk and causes a dial indicator to rotate by means of a ratchet and pan scales. The Milkometer face is one of the two dials; the other face is an electric clock whose hand is geared so that 1/6th of a minute is the same number of degrees rotation as produced by 1-lb. of milk on the Milkometer.

When the device is started, the two hands are zeroed and the clock advances towards the retreating weighing mechanism until they are in the same position. When this occurs, the two electrical contacts are made which cause an audible or visual alarm to be sounded to draw the milker's attention to the fact that theoretically, over-milking is about to occur. For slow milkers, this will be too soon; for fast milkers, too late.

2. CHECKING PERFORMANCE:

The second computing device is an adaptation of the instrumentation used for compiling P.M.T.S. (Predetermined Motion Time Standards), and is a series of electrical contacts and relays which cause electrical impulses to be made on 27 channel tape-recorder which is capable of converting analog inputs into digital

output. Such devices have recently been available quite cheaply, ($1,000)as surplus, being used originally for recording the condition of aircraft controls. The 27 channels are connected to each milking machine control, such as valves, the entrance gates to the parlour, the feeding mechanism of each stall, the udder washing facilities, the analog device mentioned above and Servis Recorders which are used to sense the passing of a cow through gates or entrances and exits.

The extent of the sophistication of the sensing devices will depend on the type of data with which the tape recording is to be compared. For example, it might be required to know how much the actual over-milking was by comparison with the theoretical over-milking. If a coiled plastic transparent tube, and a photo-electric cell is arranged with mirrors so that it detects and breaks a circuitry whenever a completely emptv length of tube occurs, this break in circuitry can be contrasted with the over-milking device mentioned above. This will provide the input on one of the 27 channels with an indication of when theoretical over-milking and actual over-milking occur. This can be recorded without any knowledge of the actual weight of milk yielded. For an over-all appraisal of milking performance, it is only necessary to know the practical amount of milk extracted and the number of cows milked.

The 27 channel tape would be calibrated in time so that for each signal from each of the channel detectors, a time/date could be applied to the condition throughout the milking.

The electronic digital computer would then calculate the average times for each of the major elements of dairy work and contrast these, for analysis purposes, with standard time data. In order to select the correct standard time data, some punch card information would be added by the analyst, indicating the type of milking parlour, the over-all performance standards to be selected from the catalogue which would be kept within the computer memory.

It should be clear that the cost of analysing performance in this way, is unlikely to be warranted by any but the larger dairies, where one man is responsible for several hundred cows per day.

It is possible however, that such a programme for a colmputer could be used and provided quite cheaply to many dairy farmers in much the same way as the routine recording of milk yield is provided as a service. This possibility, unlike the third example given below, is as yet only in the theoretical research stage. It is mentioned in this article only to indicate that there is a means of using Work Measurement Date and computers if the farmers or their advisers, can provide the necessary finance.

3. SELECTION OF CORRECT NUMBERS OF MACHINES; STALLS & WORKERS:

The problem of working out what is the best combination of units to stalls for any given work routine and feeding policy, is one which has considerable mathematical complications. The queuing or waiting of one machine or stall for a complete batch to empty the stalls, or the rate at which cows will milk and the order in which they will present themselves for milking is full

of a great number of possibilities, permutations and combinations. One of the ways of resolving such a problem is to simulate them, using mathematical models in which one can use a computer to undertake the arithmetic of a great number of possible ways and combinations, using random combinations of half the slow milkers etc. This means that a great number of trials can be made to see the actual outcome on average. Such a digital computer programme was perfected in 1967 by van Hoven, at the Instituut Voor Landbouwtechniek en Rationalisatie.

An electronic digital computer programme exists in Holland which can be used to assist in the decision, on any dairy farm, of the correct ratio of numbers of machines:stalls:cows:men, in a parlour. Although the calculation devices described in this Paper would appear to give "cut and dried" firm answers, they are only based on the average performance and average arrival of work at the milking point. A great deal of mathematical simulation is required if all the possibilities of combinations and permutations of different milk yields, milking times and work pattern frequencies, are to be assessed. A simulation programme has recently been perfected in Europe which may provide for far more realistic use of the Time Standard data. With the simulation programme, farmers can assess what will be the likely actual worst, best and average performances to be obtained from a specific installation.

APPENDIX 1.

(1) Dairy Enterprise Data; Canadian Farm Digest, Vol.6., No. 1. December, 1967.

(2) Clough & Dodd; "Machine Milking"; Bulletin #177; Ministry of Agriculture, Food & Fisheries; H.M.S.O. 1959.

(3) Nix, J.S.; Belshaw, D.G.R.;& Weller, J.B.: "The Yard & Parlour: Capital Costs & Work Requirements"; School of Agriculture, University of Cambridge, Report #58; July 1962.

(4) Martinot, M.R.; "Rapport Final de Synthese"; Chef de la Section Technique Centrale de l'Habitat rural au Ministere de l'Agriculture (France); CIGR; (CIOSTA/FAO); May, 1966.

(5) Albright, J.L., "Problems in Increasing Size of the Dairy Herd"; Department of Animal Science, Purdue University, Lafayette, Indiana.

(6) The Business Magazine for Top Dairy Farmers : "Dairy Herd Management"; (Agway Experimental Dairy Housing System at Gayway Farm, Weedsport, New York). October, 1965.

(7) Dawson, Robert C., "Electricity Makes Milking a Pleasure Not a Chore"; Educational Director, Babson Bros., 2100 South York Road, Oak Brook, Illinois.

(8) Morris, W.H.M., & Vestergaard, E.C.; "What to Expect from the Herringbone Milking Parlour"; ASAE Paper #58; ASAE Winter Meeting, Chicago, 1958.

(9) Morris, W.H.M. & Nygaard, Anders; "The Utilization of Calculations on Farm Work for Decision Making in Farm Management"; Purdue University, Lafayette, Indiana.

(10) "Standard Time Data for the Operator of Side Entering & Herringbone Milking Parlour"; (Department of Agricultural Engineering, University of Alberta).

(11) Belshaw, D.G.R. & Scott, A.H.; "Work Routines & Work Elements for Yard, Parlour & Cowshed Systems"; Supplement to Report #58, Farm Economics Branchm School of Agriculture, Cambridge University.

(12) Clough, P.A.& Quick O.J.,; "Work Routines & Herringbone Milking Parlours"; Farm Building Association Journal #11, December 1967. Paper given to Ergonomics Research Society Conference, 21st April 1967.

(13) Uldall-Ekman, Erik; "Rototandem Milking Machine for Large Cow Herds" Denmark, L.B.M. Sorø, Farm Buildings Journal #11, p.197.December 1967.

To Make the Slide Rule

1. Glue the sheet to a piece of cardboard.

2. Cut with a razor blade between Scales A & B and between D & E.

3. Stick Scales E and A on to a board or stiff cardboard so that the piece with Scales B, C, and D can slide freely.

4. Trim the edges of the board so that they are parallel to the razor cuts, and the board is just under 3" wide.

5. To make a hairline cursor cut an aperture 2" x 2" one inch from the end of a piece of card 3" x 6", fold this card so that it is 3" x 3". Across the aperture sandwich a hair between transparent adhesive tape so that it is at right angles to the fold.

6. Fit the folded hairline over the slide rule.

To Find the Labour Cost per Cwt Milk

1. Set the arrow of Scale B (left-hand) against the average milk yield obtained per cow per milking.

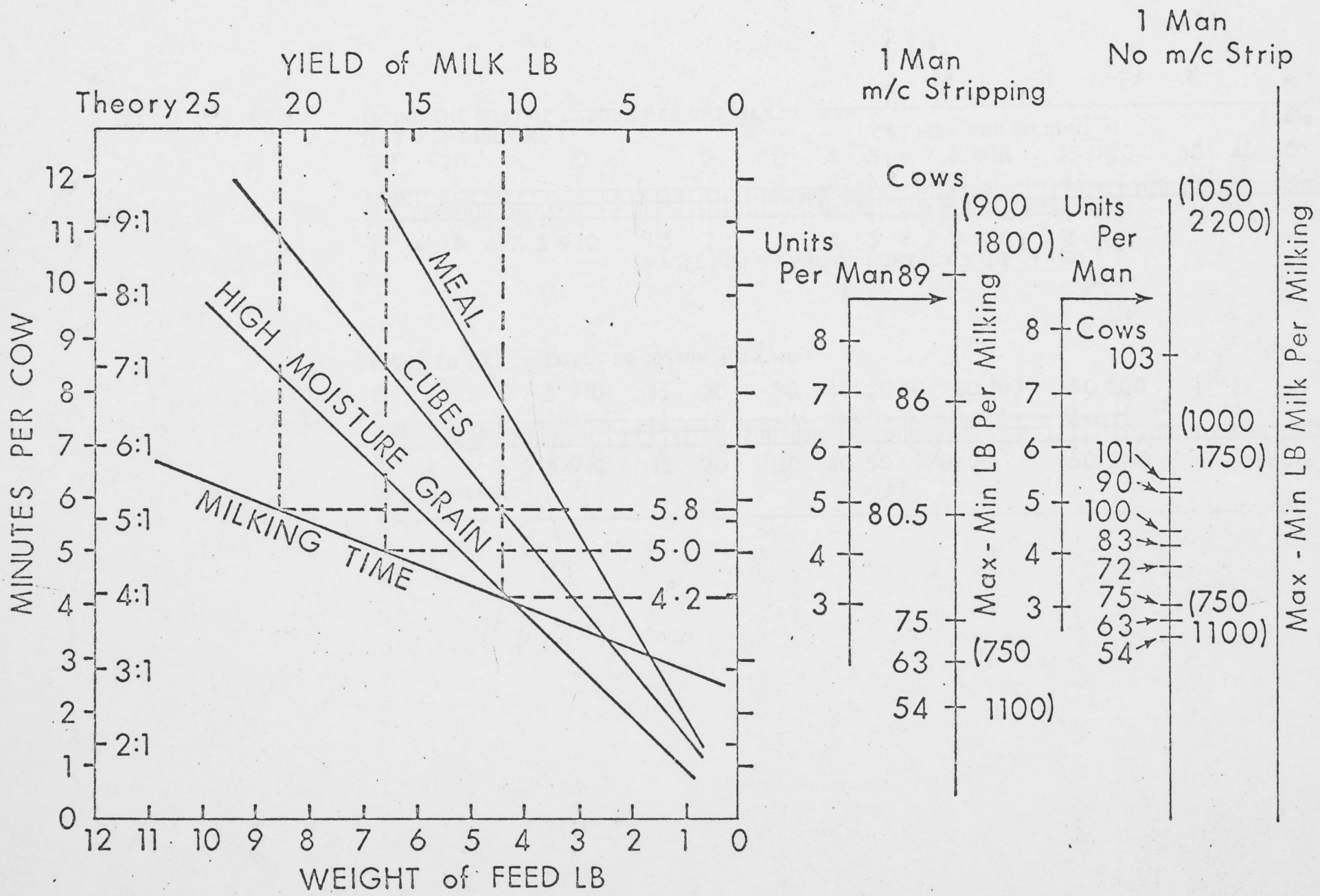
2. Set the hairline on the number of cows milked (Scale B) and read off the cwt milk/milking on Scale E (right-hand end).

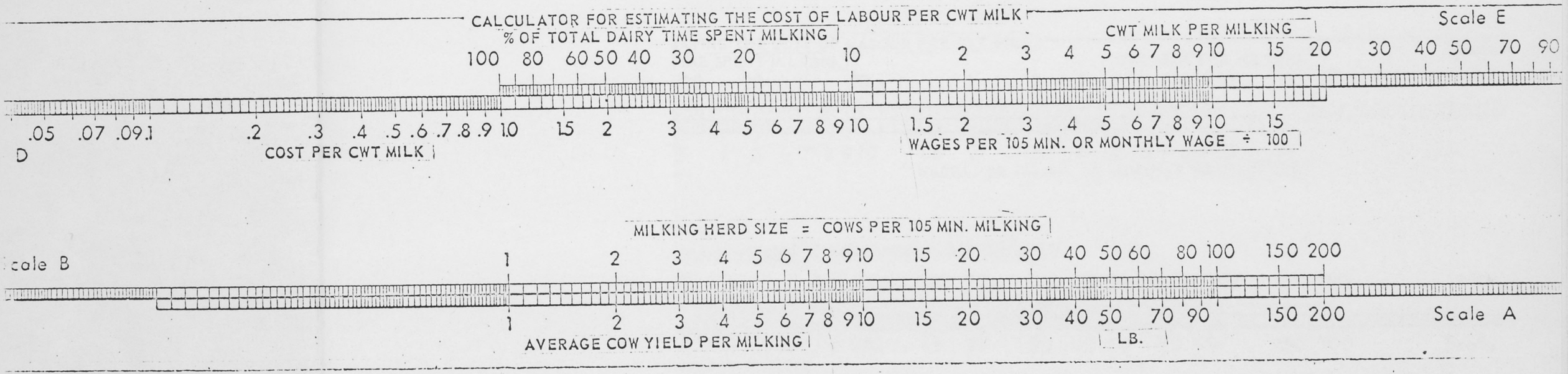
3. Set the hourly wage on Scale D against the hairline on Scale E (from 2 above).

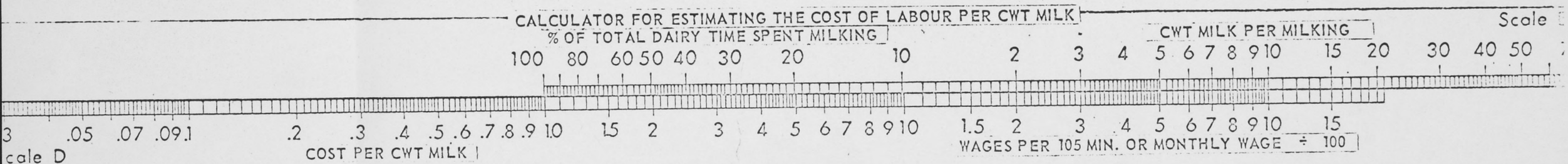
4. Move the hairline to the percentage on the Scale C and read off the cost per cwt. on Scale E at the left-hand end.

NOTE: It is possible to adapt this procedure to show how if the herd size increases, costs may be reduced. OR, if the percent of the time spent on other work is reduced how much the cost per cwt. will decrease. It is also possible to calculate how wage increases can be made to follow herd size increments and reductions in non-milking work.

Max Cows/Milking 1 3/4 hrs
Showing Max - Min LB/Milking




CALCULATOR FOR ESTIMATING THE COST OF LABOUR PER CWT MILK
% OF TOTAL DAIRY TIME SPENT MILKING
100 80 60 50 40 30 20 10
CWT MILK PER MILKING
Scale E
2 3 4 5 6 7 8 9 10 15 20 30 40 50 70 90
.05 .07 .09 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0 1.5 2 3 4 5 6 7 8 9 10
1.5 2 3 4 5 6 7 8 9 10 15
D
COST PER CWT MILK
WAGES PER 105 MIN. OR MONTHLY WAGE ÷ 100
MILKING HERD SIZE = COWS PER 105 MIN. MILKING
cale B
1 2 3 4 5 6 7 8 9 10 15 20 30 40 50 60 80 100 150 200
1 2 3 4 5 6 7 8 9 10 15 20 30 40 50 70 90 150 200
Scale A
AVERAGE COW YIELD PER MILKING
LB.


CALCULATOR FOR ESTIMATING THE COST OF LABOUR PER CWT MILK
% OF TOTAL DAIRY TIME SPENT MILKING
100 80 60 50 40 30 20 10 2 3 4 5 6 7 8 9 10 15 20 30 40 50
CWT MILK PER MILKING
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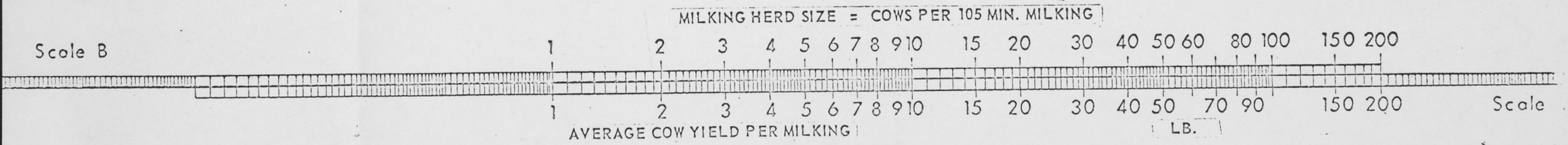
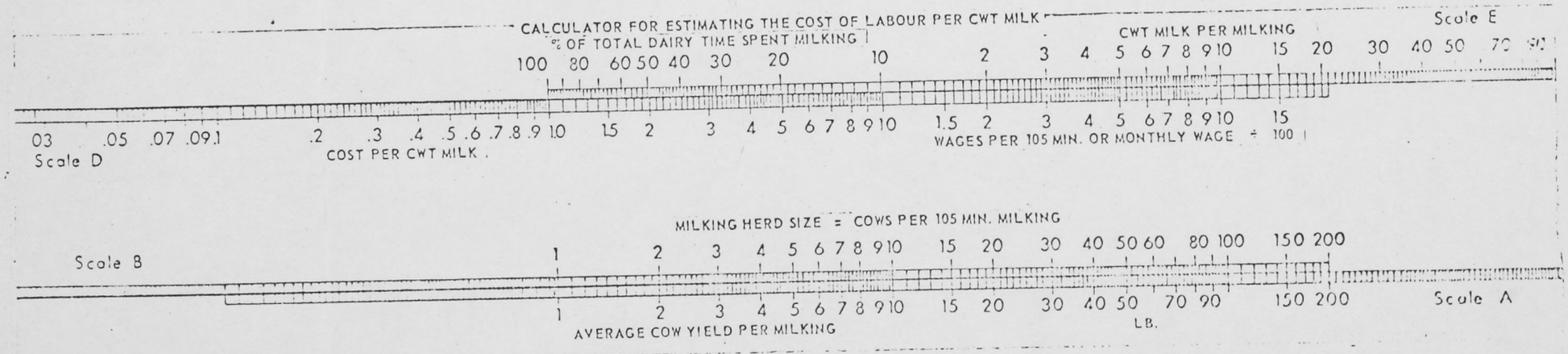
cale D
COST PER CWT MILK
WAGES PER 105 MIN. OR MONTHLY WAGE ÷ 100


MILKING HERD SIZE = COWS PER 105 MIN. MILKING
Scale B
1 2 3 4 5 6 7 8 9 10 15 20 30 40 50 60 80 100 150 200
1 2 3 4 5 6 7 8 9 10 15 20 30 40 50 70 90 150 200
Scale
AVERAGE COW YIELD PER MILKING
LB.


CALCULATOR FOR ESTIMATING THE COST OF LABOUR PER CWT MILK
% OF TOTAL DAIRY TIME SPENT MILKING
100 80 60 50 40 30 20 10 2 3 4 5 6 7 8 9 10 15 20 30 40 50
CWT MILK PER MILKING
Scale E
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Scale D
COST PER CWT MILK
WAGES PER 105 MIN. OR MONTHLY WAGE ÷ 100
MILKING HERD SIZE = COWS PER 105 MIN. MILKING
Scale B
1 2 3 4 5 6 7 8 9 10 15 20 30 40 50 60 80 100 150 200
1 2 3 4 5 6 7 8 9 10 15 20 30 40 50 70 90 150 200
Scale A
AVERAGE COW YIELD PER MILKING
LB.

ELEMENT	LOCATION	& GOULD	& SCOTT	'CINE' DATA	VESTERGAARD	FARM 1.	FARM 2.	FARM 3.	FARM 4.	FARM 5.
Wash cow with cloth	Parlours	.34 summer .42 winter	.42	.12	Prepare cow	-	-	-	-	-
Wash cow with hose	Parlours	-	-	.09		(1).24	-	-	.10(22)	.12
Wash cow with cloth	Cowshed	.34	.44	-	.30	-	-	.43(15)	-	-
Use strip cup	Parlours	.15	.15	.14	-	(2).15	(6).15	-	-	-
Draw Foremilk on Floor	Parlour	-	-	-	-	-	-	-	.07(23)	-
Draw Foremilk on Hand	Parlour	-	-	.11	-	-	-	-	-	-
Feed Rope	Parlour H/Bne	-	-	.02	-	-	-	-	(35[a])	.02 per .21 ra
Crank	Parlour T/dem	-	-	.01	-	-	.10 per ration (7)	-	-	-
Scoop	T/dem Parlour	.06	.06	.04	-	-	-	-	-	-
Using electric metering device	H/Bone Parlour	-	-	-	-	-	-	-	.17 average for 4 cows (24)	
Use Strip cup	Cowshed	.15	.11 - .22	-	-	-	-	-	-	-
Machine Strip	Parlour	.40	.40	.26	.20	(5).23	.42 Average time remove (8)	-	.37(25)	.27
Hang up unit	Parlour	.06	.06	.02	.16	-	-	-		.04
Carry Unit across Pit	Parlour	-	.05	-	-	(3).04			.05(26)	.05
Prepare Cluster	1 side Parlour	.07	.06	-						.07
Apply Cluster	Parlour	.11	.11	.12	.17	(4).15	(9).12		.12(27)	.16
Dry udder with paper towel.	Parlour			.11		.19				
Dry udder with cloth	Parlour									.09
Dry udder with sponge	Parlour								(28).08	
Dip teat cups	Parlour			.06						
Open Headgate	H/Bone Parlour			.04	.06 - .08				(31).04	.04
Close Headgate	H/Bone Parlour			.04					(32).05	.03
Open Tailgate	H/Bone Parlour			.03	.14 - .21				(29).05	.04
Close Tailgate	H/Bone Parlour			.05					(30).05	.05
Open Headgate	T/dem Parlour	.03	.03	.03						
Close Headgate	T/dem Parlour	.03	.03	.04						
Open Tailgate	T/dem Parlour	.03	.03	.02						
Close Tailgate	T/dem Parlour	.03	.03	.04			.05(10)			
Open Parlour door (O'head cord)	Parlour	.03	.03	.05						.0
Close door by rope	Parlour		.03	.04						.0
Dump Rollo Measure	Parlour			.02						.0
Right Rollo Measure	Parlour			.04						.0
Record Milk Weight	Parlour			.09						.1
Grease udder after milking.	Parlour			.07			.10(11)			
Pick up Cluster out of bucket store in Randel	Parlour						.20(12)			
Pick up Cluster remove from Randel place in bucket	Parlour						.10(13)			
Swing randal from under cow.	Parlour						.04(14)			
Wring out sponge before drying udder	Parlour								.09(23)	
Use Strip Cup	Cowshed	.15	.11 - .22							
Strip	Cowshed	.40	.33 - .55							
Remove Unit	Cowshed	.09						.08(16)		
Disconnect Machine	Cowshed		.08							
Change Buckets	Cowshed	.11	.10							
Tip Milk	Cowshed	.08	.08					.07(17)		
Prepare Unit	Cowshed	.16	-					.17(18)		
Put on Cluster	Cowshed	.11	.10 - .11							
Remove lid from bucket place cluster in disinfectant	Cowshed							.12(19)		
Weigh Milk	Cowshed							.09(20)		
Reassemble Unit	Cowshed							.10(21)		

(All elements rated 100 = normal working speed : no rest allowan

Introduction. Farm No. 1. : Elements 1 - 5.

Studies on this farm indicate a total Element time of 1.70 minutes per cow.

Initially the two men milked in rotation, one man milking mornings only and one afternoons only, the following week the routines being reversed. Calf feeding was done in the morning by the man who milked in the afternoon and in the evening, by the other. Other chores, such as bedding down and feeding were shared by the two men. The arrangement broke down however, when an outbreak of mastitis occurred, whereupon both men began milking morning and afternoon. Disagreement then resulted in one man taking over the whole milking operation and the remainder of the farm chores being performed by the other. It will be gathered from this fluid state of affairs that the milking operation is a difficult one.

A four unit 8 stall tandem is in use with rollo measures for daily recording, as the Holstein herd is a pedigree one. Usually 70 - 75 cows are in milk at one time. The actual farm building layout is good, one slight disadvantage however, is that the young stock and calves, together with the tractor, are housed in a barn and a further 24 yearlings in open yards, with roofed in loafing areas, and 25 - 30 steers in a similar yard nearby.

Personnel.

A herdsman and an assistant are employed, the former an expert and conscientious dairyman, the latter less inclined to milking cows. Occasional help is provided by a worker from the nearby Indian Reserve, who helps with bedding down and feeding the stock.

Routine.

It is proposed to outline the three situations which were encountered during the period of the study.

Routine I.

This was when one man was milking on his own though even here, there were slight variations in the methods of the two men. In all cases, the parlour is left ready to commence milking. Everything is in place and all eight tail gates are open. One entrance door is opened and held open whle four cows enter; tailgates A and B are closed at the same time. Two cows are washed, using a spray, and dried with a paper towel. The teat cups, which are hanging up, are then applied.

The process is repeated for the other two cows. The herdsman now walks to the second entrance and lets in 4 more cows. The routine now becomes variable; in some instances the unmilked cow is washed and the foremilk drawn; the herdsman returns, strips, removes the unit and places it directly on to the prepared cow. If the rollo measure is full of milk, there is a tendency to strip and remove the unit, hang up the cluster, invert the rollo and proceed to prepare the cow while the milk is pumped into the pipeline, and the speed of the whole operation would appear to be governed by the rate at which the rollo is emptied, (approximately 2 minutes if it is full). At other times, the unit is put directly on the cow opposite. When three or four cows have been milked, the head gates and exit door are opened and the cows let out; at the same time, the feed troughs are refilled and the tailgates opened. The herdsman returns and lets in a further batch of cows. Recording is done at irregular intervals by the herdsman, while the other worker records after every cow is milked.

Routine II.

When both men were milking at the same time, each man used two units and the additional element of placing the teat cups in a bucket of disinfectant solution between cows, was introduced; also a strict routine was adhered to, as there was insufficient work for the two men. Therefore, each cow was washed and the strip cup used, whereas in the earlier routine, there was a tendency to just check various cows at random. The task of letting cows in was shared by the two men, although the majority of the time it was the herdsman working the two units nearest the entrance, who opened the door. A similar situation was apparent in the letting out of the cows after milking.

Routine III.

When the herdsman took over the whole milking operation, there was a tendency to economize on the time devoted to each cow, due to the pressure involved in keeping up with four machines working; the routine therefore suffered considerably. As in Routine I the cows were let in in batches of three or four, washed by dipping a paper towel in the bucket of disinfectant rather than using the spray; the strip cup was only used occasionally, the foremilk usually being drawn straight on to the floor, prior to putting on the teat cups.

Having outlined the routines, the following are the times obtained during the course of the study:-

Washing the Cow/

A spray jet is situated in a spring clip attached to the stanchion at the rear of each stall. The milker removes the hose, washes the udder of the cow and then replaces the hose in the clip.

(1)

Herdsman	Assistant
.24	.24

Dry the Udder.

After washing, the milker reaches for a paper towel, situated either behind the cow or on the stall directly opposite. See Table 1. The udder is thoroughly dried and the towel thrown into a waste bucket.

Herdsman	Assistant
.36	.19

This variation between the two men is probably due to the degree of thoroughness with which the udder is dried; also, the herdsman tends to include a certain amount of stockmanship when drying the udder, inspecting the teats for sores, etc..

Apply Unit.

This element is one of the most difficult to define as it changed from visit to visit. Therefore, it was impossible always to use the same breakpoint. At first, when the clusters were applied directly on to the cow without dipping, the unit was either hung up between cows, to allow the milk to be pumped from the rollo measure, or else, if there was sufficient space capacity in it, the unit would be simply carried across. The break point decided on was when the cluster had been lifted off the hook or alternatively, when it had been carried across and was in a similar position to if it had been lifted off the hook. It is appreciated this is not a good policy, and if the situation had been stable and of a useful work study type, a more accurate breakpoint would have been arrived at. After the 4 teat cups have been applied, a randal is swung under the udder of the cow and the milk and vacuum pipelines attached to it with metal rings.

(4)

Herdsman	Assistant
.20	.18

When the practice of dipping the teat cups in disinfectant between cows was adopted, it became easier to define the

elements, as when the unit was removed from one cow it was placed in a bucket. There were two distinct elements; the preparation of the cluster and the application. In this instance, the preparation element was found to be highly variable, .05 - .73, as the herdsman tended to pick up the cluster and then wait while the last of the milk drained from the rollo measure before he inverted it and then applied the unit; an average figure of .24 was obtained. The task of actually putting the teat cups on the udder, as expected, was the least variable element, a time of .15 being obtained.

(2) Use Strip Cup.

As stated earlier, the use of the strip cup was erratic. A time of .154 was obtained for this element.

Letting in Cows.

Theoretically, this movement should be composed of the tasks of merely opening and closing the parlour door; in this instance, it was the combination of a number of elements. The door was opened using a rope, the position of which is shown in Fig.II, and a varying number of cows admitted, usually three or four at the same time. Using the free hand, the herdsman closes the tailgates of A, B, F, or E; if these stalls are in use, any cows apart from these, walk past. The door is allowed to close and the cows are prepared for milking. It will be appreciated that this again, is a variable element and not of any use as standard data. A time of .27 or an average of .09 - .10 per cow was obtained.

(5) Machine Strip .23

The operator strips the remaining milk out of the udder breakpoint as teat cups fall awayffrom udder, .2.

Letting out Cows.

This element is in the same category as the one above, as it is highly variable and difficult to define. The herdsman opens the headgate and tailgate, letting out the cow, and at the same time, feeds, using a lever regulated hopper. He then closes the headgate and walks to the end of the parlour and opens the exit. If cows are being let out of stalls D or H, very often the exit will be opened at the same time as the headgate. A time of .58 an operation, or .145 per cow was obtained.

Walk Length of Pit Returning to Entrance After Letting out Cows.

This is a constant element with little variation. Time .13.

(3) Walk Across with Unit.

This element was only timed when the clusters were being carried straight across the parlour and applied to the next cow or hung up. Time .04.

TABLE I.

Milking A.M. with 2 men milking;

	Herdsman		Assistant		
	Unit A.	Unit B.	Unit C.	Unit D.	Total
Machine Time	113.72	107.46	118.15	115.80	455.13
No. Cows Milked	16	14	17	18	65
Machine Idle	19.69(14.8%)	15.29(11.5%)	21.81(15.6%)	20.09(14.8%)	76.88(14.2%)
Total Milk Time	133.41	132.75	139.96	135.89	542.01
Total Milk Yield	384	352	331	384	1451
Mean Milk Time	7.12	7.68	6.95	6.43	7.00
Mean Idle Time	1.31	1.18	1.36	1.18	1.26
Mean Milk Yield	24.0	25.1	19.50	21.30	22.0
lb. per min.	3.38	3.28	2.80	3.31	3.19
Cows per hour	7.2	6.3	7.3	7.9	7.1 (28.8)

Milking A.M. Herdsman only Milking.

Machine Time	131.37	122.56	136.40	132.79	523.12
No. Cows milked	16	18	19	17	70
Machine Idle	23.57	24.13	19.73	18.85	86.28
Total Milk Time	154.95(15.2%)	146.69(16.4%)	155.13(12.78%)	151.64(12.4%)	608.41(14.2%)
Total Milk Yield	446	512	441	428	1827
Mean Milk Time	8.21	6.81	7.18	7.81	7.47
Mean Idle Time	1.57	1.42	1.10	.83	1.31
Mean Milk Yield	27.90	28.44	23.21	25.18	26.1
lb. per min.	3.39	4.18	3.23	3.22	3.49
Cows per hour	6.2	7.4	7.4	6.7	6.9

Milking P.M. Herdsman only Milking.

Machine Time	105.01	119.28	104.50	102.28	431.07
No. Cows milked	17	18	19	17	71
Machine Idle	19.90(15.9%)	13.25(10.0%)	24.13(18.8%)	26.38(20.5%)	83.66(16.2%)
Total Milk Time	124.91	132.53	128.63	128.66	514.73
Mean Milk Time	6.17	6.63	5.50	6.02	6.15
Mean Idle Time	1.24	.78	1.34	1.66	1.27
Mean Milk Yield	-	-	-	-	17.95
lb. per min	-	-	-	-	2.93
Cows per hour	8.2	8.2	8.9	7.9	8.2

Description of Alberta Study, Farm No.2. : Elements 6 - 14.

The milking and associated routines were studied in twelve visits. The farm is approximately 640 acres and is almost entirely devoted to dairying. One man is employed full time and he does the majority of the milking. The owner and his father assist with all the other operations, including calf feeding.

When the study was first commenced, the milking parlour was single-sided, but another side was in the course of construction. It came into operation, at the beginning of January, as a two-sided parlour. Though primarily the study was concerned with the collection of standard routine data, a certain amount of information on actual cow milking times was also obtained. Between 43 and 45 cows were being milked throughout the period of the study. Diagrams of the farm buildings and parlour layout are to be found in Figures III and IV. The two milking routines are therefore considered separately and are referred to as Routine I, which is that in operation when a single sided parlour was being used and Routine II, when the second side came into operation.

Routine I.

The parlour was, at this time, of the three stall single sided tandem variety, whose location in relation to the rest of the farm buildings is shown in Appendix I. Cows mount a ramp and enter at the side. On entering, the cows are fed and washed, using a damp paper towel; the foremilk is checked using a strip cup and the unit applied. Between cows, the teat cups are placed in a bucket of disinfectant in the centre of the pit. As milking proceeds, teat cups are removed when the quarter is milked out and minor adjustments are made to the randal. When milking is complete, the unit is removed and the cluster placed in a bucket of disinfectant. The four teats of the cow are individually dipped in a container of disinfectant oil, which is kept in a rack immediately behind the cow. The headgate is then opened and the cow let out. The parlour exit door is kept open the whole time, apart from during severely cold weather.

Routine II.

When the second side of the parlour was brought into operation, the routine was substantially altered, in that instead of having a one unit/one stall combination, with the attendant long machine idle time, a one unit two stall operation, which theoretically should have been far more efficient, came into being. One serious drawback however, was the fact that the cows had to be trained to come in through entrance 2, as well as entrance 1, cross the bottom of the pit, mount several steps and enter the stall. This added factor had

an important effect on the routine, in that the herdsman opens the entrance door, waits to see the cow enter, and then feeds the appropriate stall to entice her in. As the cow enters, he picks up a paper towel, dips it in the wash water, walks with it in one hand; with the other hand he closes the tailgate and then washes the cow. He then returns to the cow which has finished milking, removes the unit, places the cluster in the bucket of disinfectant, dips the four teats in oil, opens and closes the headgate and returns to draw the foremilk of the cow opposite, prior to applying the milking machine. Having outlined the two routines, in order to formulate a routine time, it is necessary to define the actual elements comprising the routine.

Open the entrance door.

This commences when the herdsman reaches for the rope hanging overhead in the centre of the parlour pit and ceases when he lets go after the cow enters. This naturally is, in this instance, a highly variable element, depending on the pressure of cows surrounding the entrance and their inclination to enter the parlour. In order to avoid banging the door, the rope is held and not released abruptly when the animal has entered.

(7) Feed .10.

Feeding starts when the hand approaches the lever controlling the hopper mechanism and is completed when the hand moves away from it, after having made a number of up and down movements, theoretically varying according to the ration to be received by the incoming cow.

Wash.

This element is difficult to define in that a paper towel is taken from a container attached to stall B, dipped in a bowl of disinfectant in the same location. The herdsman now walks; feeds, and closes the tailgate in the case of stalls C and F, and commences washing the cow. In these two instances therefore, the element is in 2 parts, separated by the feeding and tailgate closing. In the case of the other stalls, the washing is carried out in one movement, after the tailgate is closed. Another complicating factor is that, on occasions when a cow has a particularly dirty udder, a second paper towel is used, which involves returning to the container and repeating the operation. This virtually doubles the time needed to wash a cow.

(6) Use a strip cup, .15.

This is one of the least variable elements in the milking operation. Three strip cups are in use and are situated on the raised standings, immediately in front of the cow. The movement commences as the herdsman reaches for the cup and is completed after all four quarters have been checked, the cup replaced on the standing, and the hand moves away.

(12) Pick up cluster & prepare. .20.

The cluster is in a bucket of disinfectant, situated in the centre of the pit; the herdsman bends down, picks up the head, allows the excess disinfectant to drain off, then, with his free hand, opens the clip on the vacuum line and places the unit in the randal before swinging the assembly under the cow.

(9) Apply Cluster. .12

The four teat cups are applied to the udder of the cow; the randal is then adjusted and the movement completed as the hand moves away from the randal.

(8) Remove teat cups. .42 for 4 teat cups.

This element is one which requires a great deal of additional data in order to arrive at any definite times, as it is highly variable. The number of teat cups removed at any one time varies, as does the degree of machine stripping and randal readjustment. In some instances two teat cups are merely removed as the herdsman passes the stall while performing other tasks; in others, a quarter is stripped out and several adjustments made to the position of the unit. On the one occasion when the method was studied, of 43 cows milked, in 13 instances the unit was removed in one movement, giving a stripping time of .26; a further 16 cows were visited once before the unit was removed, giving a stripping time of .38 and 13 required three visits in all, totalling .56 on average. One cow had each teat cup removed individually, total time 1.20. The average machine stripping time for all cows was .43.

(14) Remove the unit, .04.

This element commences when the herdsman removes the final teat cup or cups from the udder and swings the unit from under the cow. It is completed when the hand leaves the randal.

(13) Place the cluster in a bucket of disinfectant, .10.

The hand approaches the unit, picks it up, removing it from the randal and, using the free hand, the clip is applied to the vacuum line and the cluster placed in the bucket. The break point is as the hand moves away from the bucket.

(11) Dip the cow's teats in disinfectant oil, .10.

The disinfectant oil, to prevent infection and frost damage to the teats, is kept in a small plastic container, situated in the stall immediately behind the cow. The container is removed from the bracket and the four teats are dipped in the oil by lifting the container until the whole teat is immersed. This movement is repeated four times and the container is then returned to the bracket.

(10) Close Tailgate, .05.

This element was studied but further studies are required to establish a definite standard for this type of gate. In this situation the variability was greater, due to the fact that three gates were new and consequently stiff; also, on many occasions, the cows tended to stand back in the stall and a large amount of effort was needed to close the gate.

Elements present but not studied.

Three gate movements, opening and closing headgate and opening tailgate were not studied, as times have been obtained in earlier studies, and they were often linked with walking movements. The walking element was not studied, due to the difficulty of putting the facts on paper, indicating the start and finish of the element. It was also felt that other more important data would be lost while endeavouring the write down this information.

Element Times.

Open entrance	=	.26	(highly variable)
Wash	=	.23	
Feed	=	.10	
Use Strip cup	=	.15	
Pick up cluster & prepare	=	.20	
Apply unit	=	.12	
Remove unit	=	.04	
Place in bucket	=	.10	
Dip teats in disinfectant	=	.10	
Close T.G.	=	.05	

This gives a total time of 1.35 excluding walking, tailgate opening, headgate closing and opening; removal and adjustment of the unit during milking. Standard data available for gate opening and closing would estimate .09 for the three movements missed out and walking another .06, giving a total element time of 1.50, excluding any time spent in machine stripping cows.

Criticisms of the present routine.

The routine itself is good and the herdsman a keen and conscientious worker. Minor improvements could be made by the use of an electric 'dog' fence, to keep the cows up to the entrance doors. Also, the discontinuation of the policy of feeding in order to entice the cows into the parlour, will avoid loss of time. It is suggested that when a cow has been milked and let out, the tail-gate be left open, and when the unit has been applied to the next cow, another cow be let in immediately to replace her.

Introduction : Study No. 3 : Elements 15 - 21.

The milking and associated work routines on the third dairy farm were studied over a period from 9th January to 21st February, a total of seven visits being made. The primary object of this study was to obtain standard data of the actual milking operation, but times were obtained for several of the ancillary tasks associated with the dairying operation. It is important to note however, that the farm is basically devoted to the production of extremely high quality pedigree Holstein stock and therefore certain standards and practices occur which would not be necessary in the operation of a more strictly commercial milk producing enterprise.

A total of 54 animals are housed in one cowbarn, fifty in free stalls and 4 valuable, high yielders, in individual pens. Milking and all routine farm chores during the winter, are performed by two employees, apart from a certain amount of the utensil and pipeline washing, which is done by one of the owners. A further 10 dry cows and 45 young stock of varying ages are housed in a nearby barn and fifteen heifers are open-yarded, in the same area. One stock bull is also kept in a pen, adjacent to the calf house.

Present Work Schedule.

The assistant herdsman usually arrives at 4.15 p.m. to 4.30 p.m., and assembles the milking units and utensils and then awaits the arrival of the herdsman at 5 p.m., who feeds all the milk cows a concentrate ration, prior to commencing milking. Milking is usually completed in just under two hours, hay being fed during this time. The assistant commences feeding calves, while the herdsman partially washes up the milking utensils and circulates the pipeline, before going to help with the calf feeding. This is usually completed by 7.30 a.m. when both men go for breakfast for 45 minutes.

After breakfast, the herdsman feeds the dry cows and calves a concentrate ration before returning to the dairy to finish washing utensils and calf buckets and also rinsing the pipeline. Meanwhile, the assistant goes for the tractor, hitches up to a manure spreader, loads it with 10-12 bales of straw and drives round under the barn-cleaner at the far end of the cow barn. He carries the straw into the barn and starts the barncleaner. By this time, the herdsman, having completed the dairy work, begins cleaning out the cowbarn, commencing with the four pens, throwing all the soiled straw into the dung chennel. The assistant stands at the far end, forking straw under the exit hole to prevent the cleaner jamming, and moves the spreader once before switching off the cleaner and driving off to spread the manure on nearby fields. On returning, the spreader is half filled before being moved to the cow barn, housing the dry cows. Both men now clean out the calves and dry cows, using a barn cleaner, and also bed down the open yarded young stock. On alternate days, the

cleans the bulk tank and after the assistant returns from spreading the manure, both men spend the rest of the morning on miscellaneous tasks such as getting in feed hay, etc.

The lunch break is taken from 12 - 1 p.m.; incidental tasks are continued until 3 p.m. when the herdsman fills the feed barrow and feeds the milch cows. He assembles the milking machines at 4 p.m. The assistant meanwhile, feeds the dry cows and calves hay and feeds and waters the stock bull. Milking is usually completed in 1 hour. 40 minutes and hay and sugar beet pulp are fed during this time. After finishing, the herdsman washes the utensils and pipeline, while the assistant feeds the cows hay and then feeds the calves. The assistant is helped later by the herdsman to finish calf feeding, and in feeding and sweeping up behind the dry cows. Work is usually finished by 6 - 6.15 p.m.

Milking Operation.

Four Laval units are used, two by each man, each of whom milks cows on one side of the barn. The machines, buckets of disinfectant water for udder washing and the dipping of teat clusters; record sheets, funnel and tubing for attachment to milk pipeline, are all placed on a carrier mounted on two wheels, which is positioned at the far end of the cow barn, and the pipeline connected up to the funnel.

After each cow is washed, all four quarters are drawn prior to the cluster bring applied. When milking is almost complete, the next cow to be milked is washed and the milker returns, machine strips the cow, removes and carries the bucket unit to the carrier. The lid and cluster is removed, the cluster being placed in a bucket of disinfectant. The milk is then weighed, tipped into the milk conveyor funnel; the bucket placed on the floor, the unit reassembled and the milk weight recorded. The milker returns to the cow which was washed earlier, draws all four quarters and applies the cluster. He then moves the wash bucket near to the next cow to be milked. Element times for the various movements are contained in Table I.

Criticisms & Suggestions on the Present Milking Routine.

It will be noted that both men spend a great deal of their time stripping out cows. Whilst it is appreciated that this is a pedigree operation, requiring high yields, it is thought that an average of approximately 1.5 minutes is overlong. The length of time may be due to either the fact that two units per man is insufficient to keep him fully occupied and therefore, rather than appear to be standing around idle, there is a tendency to "hide away" under a cow! Or, alternatively, it might possibly be a result of there being no visible milk flow indicators being incorporated in the milking units at present, which make it difficult for the worker to see when a cow has finished milking. This would appear to be so in the case of the herdsman, who splits the stripping operation into two distinct movements. He partially strips a cow, then moves and washes the next cow to be milked and returns to finish the stripping of the first cow.

Another point noted was the relatively lower quality of preparation of the cows on the part of the assistant, as shown by the very small (.14 - .20) amount of time spent in washing a cow; also, on a large number of occasions, the foremilk was not drawn prior to applying the unit. In relation to this premilking operation, it was noted that approximately 60% of the artificial lighting in the barn was non-functional, making it difficult to see effectively in this work area. If trouble is encountered with high bacteria counts, the greater use of a strip cup can only be useful if adequately illuminated.

Criticisms & Suggestions on Routine Farm Operations.

This was the area least studied, due to the great deal of time required to obtain information, therefore the following observations are not backed by substantial amounts of data.

In connection with the cleaning aspect, it was noted that when the barn cleaner was in use, the assistant spent a great deal of his time either idly watching the cleaner, to ensure that it did not jam, or else pushing straw under the exit hole. This was, in part, due to the large quantities of straw being used and also the fact that the chain was fully loaded before starting. A possible solution might be that the spreader is left parked under the barn cleaner and the cleaner is started before all the bedding is swept into the channel, thus ensuring a more even flow of material. The assistant would then scrape behind the cows as the cleaner was running. In the context of bedding, it was noted that a large number of the electric cow trainers were non-functional, resulting in the cows soiling high up the stalls. Also, it appeared that more straw than was actually needed, was being used. (Recommended 7-1b. per cow). This resulted in morectime being spent in cleaning out the cows and also longer in preparing the milking unit prior to it being applied, as the bucket has to be bedded down in the straw.

to be brought into the assembly area and, in the afternoon on this particular farm, the silage is put ready for feeding.

Dairy Preparation Times.

Morning	Afternoon
13.45 min.	13.00 min.
13.98	15.00
11.02	
13.26	

Time to Assemble Cows.

Morning	Afternoon
9.55	11.29 (silage removed into feeding area)
6.47	13.55 " " " " "
9.53	6.75
10.42	6.50

Actual Milking.

Morning		Afternoon	
2.15 (1 side)	44 cows	1 hr.47 (1 side)	45 cows
2.17 (1 side)	44 cows	1 hr.32 (2 sides)	43 "
2.05 (2 sides)	42 "	1 hr.54 (2 sides)	43 "
2.11 (2 sides)	43 "	1 hr.49 (2 sides)	44 "

After the milking is completed, morning and afternoon, the herdsman then proceeds to carry the units and utensils back into the parlour and wash them and also circulate the pipeline with water and detergent.

Dairy Washing-up Times.

Morning		Afternoon
6.25		7.46
6.77	21.74	8.18
8.60	22.25	7.57
8.75	24.10	

After the units are washed and the pipeline left circulating, the herdsman feeds the calves situated in pens adjoining the parlour, see Table I. The calves are sometimes fed by the owner while the herdsman finishes milking. During the period of the study, the number of calves being fed fluctuated between 5 and 17. The actual feeding time was calculated as the time taken to measure out and fill the buckets with milk, carry it to the calves, feed them and return to the dairy.

ELEMENT TIMES/COW.

	Herdsman		Assistant	
	a.m.	p.m.	a.m.	p.m.
1. Wash Cow	.44	.43	.14	.20
2. Move Wash Bucket	.08	-	.09	.08
3. Strip Cow	(1.67 - 1.73)	-	(1.50 - 1.48)	(1.36-1.65)
4. Remove Unit	.08	.06	.11	.08
5. Walk to Scale	.11	-	.16	.08
6. Remove lid & Cluster; place in bucket	.12	.12	.12	.12
7. Weigh Milk	.10	.09	.10	.09
8. Record Milk	-	-	.15	.12
9. Tip Milk	.06	.06	.08	.07
10. Reassemble Unit	.11	.10	.10	.10
11. Walk to Cow	.09	.09	.15	.17
12. Prepare Unit	.20	.18	.18	.17
13. Put on Unit	.30	.14	.20	.21

N.B.

1. Element time for preparing unit may be long because of having to bed the bucket into straw.

2. Time to put on unit may be lengthened due to several high yielding cows having low udders.

MILKING TIMES.

Herdsman A.M.	Unit A.	Unit B.
Machine Time	91.14	95.95
Idle Time	10.16	10.35
Total Milking Time	101.30	106.30
Total Milk Yield	299-1b.	279-1b.
No. of Cows Milked	13	12
Mean Milking Time	7.01	7.99
Mean Idle Time	.85	.94
Cows per hour	7.70	6.77
Lb. Milk per Minute	3.28	2.91
Mean Milk Yield (lb.)	23.0	23.3

	A.M.		P.M.	
Assistant	Unit A.	Unit B.	Unit A.	Unit B.
Machine Time	91.13	92.63	86.35	80.26
Idle Time	13.07	14.19	15.15	14.44
Total Milking Time	104.20	108.92	101.50	94.60
Total Milk Yield	-	-	292-1b.	261-1b.
No. of Cows Milked	14	13	14	13
Mean Milking Time	6.51	7.13	6.17	6.17
Mean Idle Time	1.00	1.18	1.17	1.20
Cows per Hour	8.06	8.38	8.28	8.24
Lb. Milk per Minute	-	-	3.38	3.25
Mean Milk Yield (lb.)			20.9	20.1

ELEMENT DESCRIPTION & TIMES.

(15) Wash Cow, .43.

A bucket containing water and disinfectant is situated at the side of the central gangway of the cowshed, immediately behind the cow to be washed. The operator picks the udder cloth out of the bucket, allows excess moisture to drain off, washes the udder of the cow, wrings out the cloth, dries the ddder, then returns the cloth to the bucket. Breakpoint, after the cloth has been replaced in the bucket.

Move Wash Bucket, .08.

After two cows have been washed, the bucket is picked up and carried to the next pair to be washed. Breakpoint, as the operator moves away after putting down the bucket.

(16) Remove the Unit, .08.

The operator stands up, disconnects the milk tube to the pipeline and picks up the unit bucket by the handle. The breakpoint is as the operator steps off the standing.

(19) Remove the Lid, .12.

The unit is placed on the floor, the securing handle released, the lid picked up and placed on the carrier with the four teat cups submerged in a pail of water. Breakpoint, as the operator's hand moves away, after the lid and cluster are in place.

(20) Weigh Milk, .10.

The bucket of milk is picked up and placed on the hook of the spring scale. Breakpoint is as the operator's hand moves away from the bucket.

(17) Tip Milk, .07.

When the operator has noted the scale reading, the unit bucket is removed from the hook and the milk poured into a bucket on the carrier connected to the pipeline. Breakpoint is as the operator places the unit pail on the ground, after having tipped the milk.

Record Yield, .14. (Probably not accurately rated; possibly operator's eyesight poor.)

The operator picks a pencil out of a bracket at the side of the recording sheet mounted on the carrier, finds the appropriate place on the sheet and records the yield. Breakpoint, as the hand leaves the bracket after replacing the pencil.

(21) Reassemble Unit, .10.

The lid of the bucket, together with the four teat cups are picked up and then attached to the unit bucket and the handle clipped over. Breakpoint, as the assembled unit is about to be picked up.

(18) Prepare Unit, .17. (Standard .16; probably longer because of straw).

The operator steps on the standing alongside, connects the tube to the overhead line, picks up the teat cup cluster off the hook on the bucket and bends down to apply the unit. Breakpoint is as the operator bends down.

The remainder of the times included in the list of element times are not accurate, for a variety of reasons.

In addition to the actual milking operation,times were obtained for the following associated chores.

Prepare Dairy, 7.5 mins.

This included the assembly of four units which were left soaking over night or during the day. The units are carried from the dairy to the carrier just outside in the passage, leading to the cow barn. Four buckets are filled with water and disinfectant and carried to the carrier. The receiving bucket and tube for connection to the milk pipeline are carried out and the carrier is loaded, ready to wheel to the cowshed.

Wash Dairy Utensils, .18 mins.

All the units are carried into the dairy and dismantled into the unit buckets and lids, together with receiving bucket, etc., are scrubbed and put away. Teat cups are also scrubbed and carried into the tank room and connected up to the circulation. While the utensils are being washed, the pipeline is circulating.

Wash Bulk Tank, 35 mins.

The tank is scrubbed inside and out, using a long handled brush. It is then rinsed. The connecting pipeline and filter assembly is dismantled and scrubbed. This operation is carried out every other day.

Introduction : Study IV : Elements 22 - 33.

A total of 7 visits were made to the fourth farm to obtain standard times for the operation of a herringbone parlour.

The parlour is a 4 unit, 8 stall Zero Concord, which was installed in 1966 and incorporates two interesting features. One is, the cows are fed their ration of concentrates throughout their stay in the parlour, by means of an electric metering device. The other point is that the teat cup clusters are mounted on a lightweight plastic chamber, incorporating a float, which enables two vacuum pressures to be used; 11-1b p.s.i. for the actual milking and 15-1b. p.s.i. to pump the milk into the pipeline. It is claimed the lower operating pressures reduce mastitis and it was observed, judging from the condition of the filter pad in the pipeline, there would appear to be some justification of this claim.

The farm is operated by the pwner and his son, with the assistance of two workers performing the majority of the manual chores. A total of 55 cows were being milked; all the heifer calves are reared and the bull calves are sold, shortly after birth.

Present Routine.

The owner's son and the two workers, commence work at 5.15 a.m. The son prepares the dairy, sanitising the pipeline and carrying and assembling the milking units in the parlour. Meanwhile, the workers release the cows in the cowbarn and drive them to the collecting yard, see Diagram, Table I.

All the milking is done by the son or his father. During the milking, the barn is cleaned by the two men and fresh straw/sawdust put in the stalls, and silage is fed. As the cows are milked, they are tied up again in the barn and, after the silage ration is eaten, hay is fed. The employees feed the calves during this time. When milking is completed, the collecting yard is scraped manually, all the manure being heaped near the barn cleaner. The owner and his son wash the dairy utensils, then adjourn for breakfast at approximately 7.30 a.m. After breakfast, approximately 8.45 a.m., both men finish cleaning the cow barn and collecting yard, using the barn cleaner and a manure spreader. Two journeys are necessary to spread all the manure on nearby fields. The remainder of the morning is spent on the routine tasks of exercising and bedding the young stock, filling the silage trucks, using a chopper blower, and on other chores. Hay is again fed at noon, to the cows. The cow barn is cleaned out again immediately prior to milking at 5.15 p.m., silage and hay again being fed after milking.

(22) Walk, .06.

This element comprises the time taken to walk from one end of the pit to the other, prior to washing or drying cows.

Pick up Spray and Test, .08.

This is done immediately prior to washing the cows. The hoses are situated on either side of the pit, midway along, hanging down. The operator grasps it, exerts pressure to release a jet of water, and sprays it on the floor until the water feels warm enough to commence washing the udder of the first cow. The spray is directed on to the udder and any visible dirt is rubbed off with the free hand. Breakpoint, as operator moves to next cow.

(33) Wring out Sponge, .09.

The sponge is in a bucket, situated on the floor of the pit; the operator bends down, picks the sponge out of the bucket, wrings out the excess water, dried his hands, then proceeds to dry the udder of the first cow. Breakpoint, as he moves away from the bucket to commence drying the udder of the first cow.

(28) Dry the Udder of one Cow, .08.

A dry rectangular sponge is applied to the udder to remove the excess moisture left after spraying. The whole udder and 4 teats are thoroughly dried. Breakpoint, as operator transfers the sponge from one hand to the other, prior to drawing the foremilk.

(23) Draw Foremilk, .07.

The operator draws the foremilk, of all four quarters of the cow, on to the floor, examining it on the floor for clots. Breakpoint, as operator moves to next cow.

(25) Strip Cow, .37.

Only an average figure was obtained for 186 readings. The operation commences when the operator begins massaging the udder and is completed when the cluster falls away in the hand of the operator.

(26) Carry Unit across the Pit, .05.

When the unit falls away from one cow, it is carried to the opposite cow and is ready for application. Breakpoint, as the operator moves to apply the unit to the next cow opposite.

Apply Unit, .12.

The operator holding the unit in one hand, picks up one teat cup and applies it to the nearside rear teat, then the far rear, far front, near front cups are applied; the milkmpipeline is situated

Milking Routine.

Both entrance and exit doors to the parlour remain open throughout milking, the cows being admitted directly into the stall, see diagram Table III. Four cows are admitted and, as each one is seen by the milker, its ration is registered on the appropriate meter. When all four cows are in, the gate is closed and the milker walks the length of the pit, grasping the udder hose half way along. He then tests the hose, allowing the accumulated cold water to run on the floor till warm water flow commences and then proceeds to wash cows A, B, C & D, before returning to the other end of the pit, where he picks the sponge out of the bucket, wrings out the excess water, dries his hands and proceeds to dry cow A. After drying, he transfers the sponge to his left hand and draws the foremilk on the floor. After this, he moves to the next cow and repeats the procedure. When all four cows are dried and checked, he walks and returns the sponge to the bucket before commencing to remove a unit from a cow which has finished milking; after stripping, the unit is transferred directly on to the cow opposite. Sometimes, however, freshly calved cows are milked into a bucket rather than directly into the pipeline; also, as milk production exceeds the capacity of the 500-gal. tank, buckets are used every second day for certain high-yielding cows, and the milk is tipped into churns.

Observations & Criticisms of the Present Routine.

This operation was very efficiently managed and only minor "methods" points were noted for obvious improvement.

1. Before the cows are washed, the operator has to walk the length of the pit to collect the udder hose and then, after washing all four cows, again walks to the other end to commence drying and drawing the foremilk. If the hose was situated at the entrance, the operator could commence washing cows in the order D, C, B, A.

2. Similarly, the positioning of the bucket containing the sponge for drying the udders. If left in its present situation, would again require the operator to walk the length of the pit. Two smaller containers, with two sponges, situated midway along either side of the pit, would reduce walking.

3. From Table III, it can be seen that the machine idle time is highly variable from 0.82 for 14 cows on one occasion, to 10.04 on another. This difference is due mainly to the use of buckets, which it takes at least .76 min. to change, whilst a normal direct transfer from one cow to another takes only .05.

4. It was noted that, although the majority of cows were stripped out quickly, certain animals, namely 48 on 3 occasions and 43 on 2 occasions, required a great deal of time. It took 6.45 minutes to finish milking the latter, one morning, a procedure which completely disrupts the milking operations. In this

respect it might be advisable if randals were to be used to support the teat cup assembly. Another point noted was, that the construction of the unit made it difficult to see then the actual milk flow from the udder had ceased and when to commence machine stripping.

5. It was noted that the machines were being left on for up to nearly 12 minutes, in some instances, and the average milking times of 7.41 and 6.94 for morning and afternoon milkings, would suggest that the cows might possibly be milked out a little quicker.

ELEMENT DESCRIPTION & TIMES.

Let in 4 cows, .31.

This is naturally a variable element, depending on the inclination of the cows to enter the parlour and the speed with which they entered. Usually, however, they were fairly constant with only occasional hold-ups, which were excluded from the calculations.

The element commences when the operator's hand moves towards the gate to open it, and is completed when the hand moves away, after closing the gate. To remove the cow variable nature of the element, it was further broken down into the constituent parts of open gate, feed and close gate. When calculated this way, the delay factors between the last cow being recognized and fed and the gate being closed, are not considered, nor are other factors, such as the delay between the gate being opened and the first cow entering.

(29) Open entrance, .05.

The operator's hand moves towards the lever opening the tail gate and pulls it, opening the gate. Breakpoint, as hand moves away to commence feeding first cow.

(24) Feed 4 Cows, .17.

This element is highly variable and should theoretically be split down to even smaller micromotions of feeding each cow. This, however, is not feasible, as the movement would consist of simply turning a knob. The figure arrived at was an average of times, varying from .11 - .18.

(30) Close Entrance, .05.

Strictly speaking, the gate should be closed, using the handle, but as the cows are usually standing well back in the stall, the gate is instead grasped and pulled closed behind the last cow. The breakpoints are, as the hand approaches the gate and after the gate is closed.

between the near front and back quarters, and not between the two front quarters. The pipeline and vacuum line are then lopped over a suspending hook, half way along the stall. The breakpoint is as the operator moves away after hooking the pipeline over the hook.

Let out 4 Cows, .37.

This element is again variable, depending on the rapidity with which the cows move out after milking is completed. It has been subdivided into the elements of opening and closing the exit gate.

(31) Open Exit Gate, .04.

The operator pulls the securing bolt toward him, releasing the gate and swings open the gate. The breakpoint is as the hand moves away from the open gate.

(32) Close exit Gate, .05.

When the last cow is out, the operator pushes the gate closed and pushes the securing bolt into position. Breakpoint is as the operator's hand moves away from the closed gate.

Parlour Set-up.

The set-up time was only recorded on two occasions and varied between 15 - 20 minutes, depending on the routine. The basic routine, which took 15 minutes, involved filling and tipping two buckets of water, containing detergent, into the wash tank and sanitising the pipeline. While the line is being cleaned, a spare is washed and placed in the bulk tank. A further two buckets of water are filled and carried into the parlour, by which time the line sterilization is finished. The pipeline connection to the bulk tank is swung into position and connected; the milking units are disconnected from the circulation position, carried two at a time into the parlour and connected up; finally the vacuum is started, the two headgates in the parlour closed and milking commences. The extra five minutes are added to the routine when, every other day, buckets are used, and are rinsed and assembled to avoid over-filling the bulk tank.

Parlour take-down.

It was virtually impossible to obtain times for this, due to the number of people involved. On occasions, three persons were carrying items and washing up at one time. The routine involves disconnecting the 4 machine units, carrying them to the dairy, where they are quickly scrubbed in one tank, position A in Table I, carried, stored in racks and connected up to pipeline in B, Table I. The circulation is started and left to run automatically. On the three occasions this operation was observed, the total procedure took from 4 - 6.5 minutes, depending on the number of people involved. Also, it would take longer if the buckets mentioned earlier, have to be washed.

Feeding.

This operation consisted of loading silage, using a fore loader into a feeder mounted on wheels and driving it to the open cattle yard, once a day. In addition, hay was fed in the hay racks to the milk cows, twice a day. Hay was also fed once day to some heifers and horses, which were out wintering. Loading the silage took 36 minutes from the time the tractor was driven from the shed, to when it was returned. Feeding hay took another 17 minutes and feeding the 22 heifers and several horses varied between 15 to 30 minutes.

Bedding.

Eighteen bales of straw were loaded on to the manure spreader and transported from the stack to the bedded area, see Table I. Six were unloaded in the smaller area and twelve in the larger area. The tractor was then driven out and parked and the herdsman returning, cuts the strings on the bales and spreads the straw, using a fork. One bale is carried and used for bedding the calves. A total time of 30 minutes is required for this task.

Associated Chores.

Get in Cows.

Driving cows out of loafing barn and feeding area into collecting yard. This element is naturally variable due to the very nature of the task and times of between 6 - 10.30 minutes were recorded with a mean of 8.28 in the morning and 7.65 in the afternoon.

Dairy Preparation.

This includes filling four buckets with water and disinfectant, taking off outdoor clothing, starting the vacuum pump and carrying the four buckets into the parlour, 4.5 minutes.

Actual Milking.

	Time	No. of Cows	Cows/hr.	Av. Milk Yield/lb.
Assistant alone	a.m. 2 hr 53 min.	71	24.6	20.8
	p.m. 2 " 31 "	71	28.2	15.4
	p.m. 2 " 25 "	67	29.4	18.1
Herdsman alone	a.m. 2 " 54 "	66	22.7	21.3
	a.m. 2 " 42 "	70	25.9	Not recorded
	p.m. 2 " 46 "	70	25.3	16.2
	p.m. 2 " 17 "	67	29.3	Not recorded
	p.m. 2 " 15 "	64	28.4	17.5
2 men milking	a.m. 2 " 22 "	65	27.4	22.5
	p.m. 2 " 09 "	66	30.6	17.0
	p.m. 2 " 21 "	71	30.2	18.0

Sweep up and Wash Parlour.

The parlour is first brushed and all the dung swept out through the exit and entrance doors. The floor is then washed, using a high pressure hose. The dairy floor is washed at the same time. Time 20.80 minutes.

Washing Dairy Utensils.

The teat cup clusters are carried from the parlour into the dairy and scrubbed, prior to being attached to the circulation, which is then started.

Clean Bulk Tank.

This was only observed once and the routine was exceedingly thorough, involving the manual scrubbing with a handbrush of the whole interior, and several rinsings. Time 31.55 minutes.

Observations and Criticisms of the Milking Routine.

As mentioned earlier, this is a difficult parlour for one man to run efficiently and do all the tasks thoroughly. The following routine times indicate the number of units which can theoretically be handled effectively by one man.

Routine Time	No. of Units	Cows per Hour
3 min	2 units	20
2 min	3 "	30
1.5 min	4 "	40
1.2 min	5 "	50

As a total of 75 cows have to be milked a routine time of, at most, 1.5 min is necessary to avoid the milker having to work for too long a period, 105 minutes being the maximum time which should be spent by one man milking at any one time. The present routine time is comprised as follows :-

		Standard Time *
Wash	.24)	
Dry	.36)	.42
Prepare Unit	.24	
Put on Cluster	.15	.11 (no randal)
Use strip cup	.15	.15
Get in Cow	.10	.11
Let out & feed	.15	.15
Walk	.04	.04
Transfer Unit across	.04	.05
Remove unit (strip)	.23	.40
	1.70	1.43

*Standard Times are included at the side for comparison.

It can be seen that the maximum throughput of cows recorded, when both men were milking, was 35 per hour and that the routine time is 1.71. This excludes the amount of time required for recording yields, changing buckets, etc. In order to improve the time, two elements are worth attention. The preparation time could be reduced considerably from the present .60 if a somewhat less thorough routine were adopted when washing and drying the udder. Another area is the amount of time spent waiting for the rollo measures to empty and consideration should be given to replacing them with some faster emptying device. The time taken to get cows in was not thoroughly studied but it is thought a moveable electric fence, keeping the cows up to the door, would be a considerable time saver, though presumably the cows enter the parlour more readily when strangers are not present.

Introduction : Study No. V : Elements 22 - 50.

A total of six visits, between 29th March and 7th April, were made to Farm V to obtain standard times for the operation of a herringbone parlour.

The parlour is a 4 unit, 8 stall, Choreboy, of the usual model operating on 15 p.s.i. vacuum. Rollo measures are used for the recording of milk yields at every milking. Milking is usually done by one man who is highly skilled and efficient. A total of 65 cows were in milk at the time the observations were made. The enterprise is strictly commercial, but a close watch is kept on milk yields, as the animals are all pedigree, and a number of bulls and cows are sold annually.

The rate of milking is also carefully observed and this was the only farm visited where the operator, rather than the cow, was in control of the milking routine; a rigid milking time was adhered to resulting, with only a few exceptions, in very even milking rates/ Very little machine stripping was practiced.

Present Routine.

The milker arrives at 5.20 a.m. and fills up the hay racks, which usually takes 12-13 minutes. He then assembles the parlour, carrying the clusters and pulsators from the dairy, one at a time, inverting the rollo measures and fitting the filter pads; connects up the bulk tank, all of which takes a further 7 minutes. He then fills a bucket with water, adds disinfectant and carries it into the parlour and commences milking.

After milking, an assistant sweeps and washes the parlour, which takes 22 minutes, while the milker dismantles the parlour, disconnects the pipeline to the bulk tank, connects the clusters to the pipeline and starts the cleaning circulation; all of this takes approximately 8 minutes, upon which the milker goes for breakfast.

After breakfast, the cows are fed silage from a trailer, which was loaded the day before. The silage is forked into a trough, (see Table I). This operation takes approximately 20 minutes. He then drives to a nearby stack of straw, loads 27 bales, drives to the loafing barn, unloads the bales in three stages, removing the string at each stage. heaving the opened bales, which the cows themselves scatter. Total time to drive load, return and unload on the one occasion observed, was 27 minutes. After feeding and bedding the cattle, other miscellaneous tasks are performed for the remainder of the day until 3.45 p.m., when the parlour is again assembled in a similar manner to the morning, and milking commences at 4 - 4.05 p.m.

(45) Close Tailgate, .05.

The gate is pushed to behind the last cow and the securing bolt pushed into position. Breakpoint, as the hand moves away from the closed gate.

(35-b) Feed 4 Cows, .21.

Each cow is fed the correct ration by pulling a rope, releasing food into the hopper, the appropriate number of times, in a downward direction. Breakpoint, as the hand of the operator releases the rope controlling the feed mechanism of the last hopper.

(34) Wash 1 Cow, .12.

A hose is situated, hanging between every other cow. It is grasped with one hand and the operator washes the udder of the cow, then moves to the next cow, washes it, releases the hose, grasps another hose and repeats the process. Breakpoints are as the operator grasps the hose and then, as he moves to the next position and finally as he releases one hose to grasp the next.

Pick up Drying Cloth from Bucket, .17.

The operator, having washed the last of the 4 cows, walks to the centre of the milking pit, bends down, picks up a cloth, stands up, wrings out the excess water from it, spreads the cloth over the palm of one hand, and is ready to dry the first cow. Breakpoint is when the cloth is spread on the hand ready to commence drying the udder of the first cow.

(41) Dry Udder of one Cow, .09.

The operator, using a dry cloth, removes the excess water from the udder of the cow. Breakpoint, as hand moves away from the udder.

(49) Right Rollo Measure, .03.

The spherical measure is tipped to the milking position after the milk from the last cow has been pumped out. Breakpoint, as the hand moves away from the measure.

Replace Cloth in Bucket, .04.

When the last cow has been dried, the operator walks and drops the cloth back in the bucket.

(39) Pick up Cluster & Prepare, .07 or .08.

In this instance two different tasks may be performed. The cluster may be picked up directly from the hook and arranged in the hand ready to apply the first teat cup directly to the udder. Time, .07.

Alternatively, the cluster may have been hung upon the opposite side of the pit. It is picked up, carried across and the remainder of the element is the same. Time, .08.

Breakpoint in both instances, is when the cluster is ready to apply to the udder of the cow.

(40) Apply Cluster, .16.

All four teatscups are applied in the order near rear, far rear, far front, near front, and the vacuum and milk tubes are then placed over a hook on the side of the stall. Breakpoint, as the hand moves away from the hook after the unit is in position.

(42) Open Headgate, .04.

The securing bolt is drawn back and the gate swung open. Breakpoint, as the operator's hand moves away from the opened gate.

Open Door, .04.

The door is opened by pulling down on a rope. Breakpoint when the door is fully opened.

(43) Close Headgate, .03.

The gate is pushed to and secured by a bolt. Breakpoint, as the operator's hand moves away from the closed gate.

(36) Strip Cow, .27 (Variable).

The milker quickly massages the remaining milk out of the udder of the cow. Breakpoint, as the cluster falls away from the udder.

(38/37) Hang up Cluster, .05 or .04.

The cluster may either be hung up on the hook of the stall of the cow just milked, (time .04) or carried across and hung up on the stall opposite, (time .05). Breakpoint in both instances, as the operator's hand moves away from the cluster hanging on the hook.

(48) Tip Rollo, .04.

The operator reads the amount of milk contained in the measure, then tips the sphere to allow the milk to be pumped into the vacuum line. Breakpoint, as the operator moves away from the upturned measure.

(50) Record, .11.

The operator walks to the boards holding the record sheets, situated on the side of the stalls, finds the cow just milked on the sheet, picks up a pencil, records the yield and replaces the pencil. Breakpoint, as the operator's hand moves away after replacing the pencil. Average time to let in 4 cows, walk and feed, 1.38 min. Average time to let out 4 cows, .54 min.

It is, however, interesting to note that machine idle time of only 6% was obtained in a parlour where no recording took place, and where the cows were milked directly into the milk pipeline. In order to utilize this machine idle time however, the parlour layout would have to be altered to allow the operator and machines to function more continuously. In this regard there are three areas where time savings could be made. These are the entrance and exit doors, and the recording. In the first instance, a great deal of time is spent walking to open the entrance door; waiting for the cows to enter, walking and closing the tailgate and then feeding. A possible improvement might be to locate the entrance tailgate and feed control mechanisms at one point, so that the operator does not have to walk away from the pit and could also feed each cow as it is recognized entering the door, thereby eliminating the time lapse between the cow entering and being fed. A similar smaller criticism exists in the case of the exit routine. The operator is again obliged to wait whilst the cows walk out, and then walk to close the headgate. If both exit door and head gates could be more easily controlled from the pit, time would be saved. Another hold up is caused by cows being unable to leave quickly, due to the pressure of other cows feeding at the trough, situated directly across the exit path from the door. The final area in which improvement might be made is in the weighing and recording, which is probably governed by the speed with which the milk can be pumped out of the rollo measure; but this again, is naturally dependent upon the recording policy of the management and the value placed upon daily, rather than weekly or monthly recording.

Element Descriptions & Times.

(35) Put Feed in all Troughs, .02.

Prior to opening the tailgate, the feed ropes are pulled to ensure that feed is present in all the troughs. The element commences as the operator reaches up to pull the rope and is completed when the hand moves away.

(46) Open Entrance Door, .04.

The operator's hand moves toward the door rope, pulls it downwards, opening the door. Breakpoint, when door is fully open.

(44) Open Tailgate, .04.

The operator's hand moves toward the securing bolt of the gate and pulls it toward him, simultaneously opening the gate. Breakpoint, as the hand moves away from the fully open tailgate.

(47) Close Door, .04.

The door is allowed to close of its own accord but a regulatory pressure is exerted by one hand on the rope, to prevent slamming. Breakpoint, as the hand releases the opening rope.

Present Milking Routine.

The operator walks the length of the pit, after having let out the last cow, gives the feeding ropes (see Table II) several quick tugs to partially fill the feed troughs, then walks to one of the entrance doors. This is opened, using a rope, and 4 cows allowed to enter, when the door is closed, the operator merely holding the rope to stop the door banging. He then walks and pushes the tailgate closed and walks to the feeding ropes and gives each cow its appropriate ration by pulling the rope downwards the correct number of times. A few steps to the first stall and he grasps a wash hose and proceeds to wash one cow, moves to the next stall and washes the second cow; releases the hose, grasps another, washes the third cow and then the fourth; releases the hose, walks to the middle of the pit at one side, where a bucket is situated. He bends down, picks out the cloth, wrings out the excess water and walks to the stall nearest the entrance door; spreads the cloth over the palm of his hand and proceeds to dry the udder of the first cow; moves on until all four cows have been dried, whereupon he walks, dropping the cloth back in the bucket while he walks. He commences machine stripping the cow on the opposite side, which has finished milking. Having stripped out the last of the milk from the udder, the cluster is hung up either on the same side as, or else carried across to the stall opposite, to be hung up ready for the next cow. The rollo measure reading is noted and then the measure tipped to empty. The operator now walks to the recording sheets situated on the stalls A-D (see Table I) and enters the milk yield in the appropriate place. After this, he moves to repeat these operations a further three times. When all four units are hung up, he returns to the first cluster removed, rights the rollo measure, picks up the cluster, if it is in the correct position; if not, he carries it across and then applies the four teat cups to the udder in the order - near rear, far rear, far front and near front. When all four are in position, the milk and vacuum tubes are picked up and looped over a hook on the side of the stall. This series of operations is repeated until all four units are milking. Sometimes, however, if one cow is known to be a particularly slow milker, the unit will be allowed to remain on while the other three are put on the next cows, before the operator returns, machine strips and then hangs up the cluster. This only occurs very occasionally. The milker now walks to the headgate, opens it and then pulls the rope opening the exit door, and allows the four milked cows out. He then closes the headgate and allows the entrance door to close. The operational cycle is then repeated.

Observations & Criticisms of the Present Milking Routine.

The present milking routine is good and, within the limitations of the existing layout is difficult to improve. As a guide, however, it may be seen in Table III, that the milking units are idle for approximately 24% of the total milking time. It is appreciated that this time includes the time taken to hang up the cluster, tip the rollo measure; allow it to empty, right the measure, carry the cluster to the next cow and also record the yield of the cows.

Actual Milking Times.

These were calculated from the time the first teat cup was applied to the udder of the cow, to when the unit was removed. The figures obtained may be found in Table III. It is interesting to note that initially, the 'unit-on' time increased substantially when the second side of the parlour was brought into operation. It is significant that this particular herd is highly sensitive to the presence of strangers during milking time, and elements may be shorter when no time-study man is present. The last afternoon's observations appeared to indicate a return trend to the original mean machine on time.

The results in Table III include only those animals present throughout the study and excludes any which calved or were dried off during the period; also one very nervous animal is excluded. The overall milking times for the whole milking operation are contained in Table IV.

The average afternoon milking time was originally 5.35 mins. per cow, with the machine being idle for 2.32 mins. between cows. When the second side was used the milking time reached a peak of 6.94, with a minimum idle time of 0.82. A similar trend is apparent in the morning, the milking time per cow rising from 6.19 to 7.66 with a minimum idle time of 0.91, compared with 2.56 previously. Therefore, although more cows were in fact being milked per hour, a substantial amount of time was being lost due to the machines being left longer on the cows. It will be noted that the idle time, (that is the time during which the machine is not actually milking), is highly variable; this is due to a number of factors. Observations 1 and 5 were of normal milkings with one side of the parlour in use; 3 and 6 were of normal milkings with 2 sides in use. Number 2 had a high idle time, due to a cow damaging a tailgate and, as a result of this fractious animal, several units were left off for longer than normal. Numbers 4 and 6 were affected by the fact that a number of animals were being treated for mastitis and were being milked into a bucket, involving the disconnection of the cluster and pipeline and insertion of the bucket. In addition to the overall increase in milking time per cow, a number of cows are responsible for wide variations in milking time; these are cow numbers 7, 27 and 54 which, on occasions, have a combined total milking time (morning) of nearly 53 minutes and, on others, only 32.5 minutes. Variations between 45 minutes and 24 minutes were observed in the afternoon. It was found that these three animals varied because of udder injury; number 7 due to having had a teat trampled on and the other two, due to severe mastitis in earlier lactations.

TABLE III

6/1/67 a.m.	Unit A	Unit B	Unit C	Overall
Machine Milking (1 side)	90/75	87.49	94.28	272.51
No. Cows Milked	15	13	16	44
Machine Idle	37.17(25.6%)	35.59(28.9%)	38.28(28.9%)	105.04(27.8%)
Mean Milking Time	6.05	6.73	5.89	6.19
Mean Idle Time	2.23	2.96	2.55	2.56
Total Milking Time	121.91	123.08	132.54	377.55
Cows per Hour	7.4	6.3	7.2	7.0 (21.0)
24/1/67				
Machine Milking	108.39	105.13	104.51	318.03
Co. Cows Milked	12	16	14	42
Machine Idle	9.86(8.3%)	24.61(12.2%)	11.32(9.8%)	35.34(10.10%)
Mean Milking Time	9.03	6.57	7.46	7.57
Mean Idle Time	0.90	0.94	0.87	0.91
Total Milking Time	118.25	119.74	115.83	353.37
Cows per Hour	6.1	8.0	7.3	7.1 (21.4)
14/2/67				
Machine Milking	115.62	112.73	100.90	329.25
No. Cows Milked	14	13	16	43
Machine Idle	11.67(9.2%)	14.99(11.7%)	27.09(21.2%)	53.75(14.0%)
Mean Milking Time	8.25	8.67	6.30	7.66
Mean Idle Time	0.90	1.25	1.81	1.34
Total Milking Time	126.29	127.72	127.99	383.60
Cows per Hour	6.7	6.2	7.5	6.7 (20.1)
22/3/67				
Machine Milking	104.88	107.67	107.82	320.37
No. Cows Milked	17	15	11	43
Machine Idle	16.46(13.6%)	14.27(22.7%)	8.80(7.5%)	39.53(11.0%)
Mean Milking Time	6.17	7.18	9.80	7.45
Mean Idle Time	1.03	1.02	0.80	0.99
Total Milking Time	121.34	121.94	116.62	359.90
Cows per Hour	8.4	7.4	5.7	7.2

Aver.A.M. Milk Yield 22.6-lb. : Milking Rate (2 sides in use) 2.97-lb. per min.

TABLE III - cont -

	Unit A	Unit B	Unit C	Overall
4/1/67 p.m.				
Machine Milking (1 side)	79.36	81.23	80.13	240.72
No. Cows Milked	15	15	15	45
Machine Idle	31.47(28.1%)	30.69(27.4%)	28.48(26.2%)	90.64(27.4%)
Mean Milking Time	5.29	5.41	5.34	5.35
Mean Idle Time	2.42	2.86	2.19	2.32
Total Milking Time	110.83	111.92	108.61	331.36
Cows per Hour	8.1	8.0	8.3	8.2(24.6)
12/1/67				
Machine Milking	88.54	86.32	90.54	265.40
No. Cows Milked	12	17	14	43
Machine Idle	19.43(18.0%)	16.52(16.1%)	14.65(13.9%)	50.50(16.0%)
Mean Milking Time	7.38	5.07	6.47	6.17
Mean Idle Time	1.77	1.03	1.13	1.26
Total Milking Time	107.97	102.84	105.19	316.00
Cows per Hour	6.7	9.9	8.1	8.2 (24.6)
18/1/67				
Machine Milking	103.11	100.65	94.50	298.26
No. Cows Milked	14	14	15	43
Machine Idle	10.20(9.0%)	9.61(8.7%)	13.41(12.4%)	32.95(9.9%)
Mean Milking Time	7.36	7.19	6.30	6.94
Mean Idle Time	0.78	0.74	0.94	0.82
Total Milking Time	113.31	110.26	107.91	331.21
Cows per Hour	7.4	7.6	8.3	7.7 (23.1)
14/2/67				
Machine Milking	87.84	90.27	95.43	273.54
No. Cows Milked	14	14	14	42
Machine Idle	21.22(19.5%)	15.75(14.9%)	10.52(9.19%)	47.49(14.8%)
Mean Milking Time	6.27	6.45	6.81	6.51
Mean Idle Time	1.63	1.21	0.80	1.22
Total Milking Time	109.06	106.02	105.95	321.03
Cows per Hour	7.7	7.9	7.9	7.8 (23.6)

P.M. : Average Milk Yield 18.7-lb. : Milking Rate 2.86-lb per min. with both sides in use.

TABLE III.

9/3/1967 p.m.

	Unit A	Unit B	Unit C	Unit D	Overall
Machine Milking	96.61	86.95	89.97	83.48	355.91
No.Cows Milked	14	13	14	13	54
Machine Idle	4.67(4.7%)	6.79(7.2%)	1.94(2.1%)	7.36(8.1%)	20.75(5.5% of total
Total Milking Time	100.18	93.74	91.91	90.84	376.76(milking time)
Mean Milking Time	6.82	6.68	6.43	6.42	6.59
Mean Idle Time	0.36	0.57	0.15	0.61	0.41
Cows per Hour	8.4	8.3	9.1	8.6	8.6 (34.4)

10/3/1967 p.m.

Machine Milking	105.80	103.55	95.88	94.66	399.89
No.Cows Milked	14	14	14	13	55
Machine Idle	2.94(2.7%)	1.31(1.2%)	3.87(3.9%)	5.43(5.4%)	13.55(3.3%)
Total Milking Time	108.74	104.86	99.75	100.09	413.44
Mean Milking Time	7.56	7.40	6.85	7.28	7.27
Mean Idle Time	0.23	0.10	0.30	0.45	0.27
Cows per Hour	7.7	8.0	8.4	7.8	8.0 (31.9)

Av. Milk Yield = 21.4-lb. Milking Rate = 3.03-lb.per min.

Average throughput = 33.1 cows per hour.

13/3/1967 a.m.

Machine Milking	105.86	99.19	101.84	100.59	407.48
No. Cows Milked	14	14	13	14	55
Machine Idle	3.11(2.9%)	5.89(5.6%)	1.51(1.5%)	1.14(1.1%)	11.65(2.8%)
Total Milking Time	108.97	105.08	103.35	101.73	419.03
Mean Milking Time	7.56	7.08	7.27	7.74	7.41
Mean Idle Time	0.24	0.45	0.12	0.10	0.23
Cows per Hour	7.7	8.0	7.5	8.3	7.9 (31.6)

Total Milking Time = 4.9.13 = 7.62 per cow. Cows per hour = 31.5

14/3/1967 a.m.

Machine Milking	95.08	104.01	97.76	110.75	407.60
No.Cows Milked	14	14	13	14	55
Machine Idle	10.04(9.6%)	3.87(3.6%)	9.34(8.7%)	0.82(0.7%)	24.07 (5.6%)
Total Milking Time	105.12	107.88	107.10	111.57	431.67
Mean Milking Time	6.79	7.43	7.52	7.91	7.41
Mean Idle Time	0,77	0,30	0,78	0,06	0.50
Cows per Hour	8.0	7.8	7.3	7.5	7.6 (30.6)

Average Milk Yield = 22.8-lb. Milking Rate = 3.07-lb.per min.

Total Average Throughput = 31.4 cows per hour.

TABLE III.

Morning Milking, 3/4/1967

	Unit A	Unit B.	Unit C	Unit D	Overall
Machine Milking	78.52	79.70	88.05	80.47	326.74
No. Cows Milked	15	16	18	16	65
Total Milking Time	106.07	110.34	107.75	109.89	434.05
Machine Idle	27.55(25.9%)	30.64(27.8%)	19.70(18.3%)	29.42(26.8%)	107.31(24.7%)
Mean Milking Time	5.2	5.0	4.9	5.0	5.0
Total Milk Yield	295	352	369(17 cows)	330	1346
lb. Per Min.	3.75	4.42	4.34	4.10	4.16
Mean Idle Time	1.97	2.04	1.16	1.96	1.76
Cows per Hour	8.5	8.7	10.0	8.7	9.0(36.0)

Morning Milking, 7/4/1967

Machine Milking	84.02	87.93	96.20	91.24	359.39
No. Cows Milked	15	16	17	17	65
Total Milking Time	106.71	120.22	124.75	124.57	476.25
Machine Idle	22.69(21.3%)	32.29(26.9%)	28.55(22.9%)	33.33(26.8%)	116.86(24.5%)
Mean Milking Time	5.6	5.5	5.7	5.4	5.3
Total Milk Yield	319	359(15 cows)	367	380	1425
lb. Per Min.	3.80	4.44	3.81	4.16	4.04
Mean Idle Time	1.62	2.15	1.78	2.08	1.91
Cows Per Hour	8.4	8.0	8.2	8.2	8.2 (32.8)

Afternoon Milking, 31/3/1967.

Machine Milking	71.58	71.36	73.83	69.15	285.92
No. Cows Milked	17	16	17	16	66
Total Milking Time	93.27	96.31	94.62	95.79	379.99
Machine Idle	21.69(23.2%)	24.95(25.9%)	20.79(22.0%)	26.64(27.8%)	94.07(26.8%
Mean Milking Time	4.2	4.5	4.3	4.3	4.3
Total Milk Yield	256(16 cows)	297	306	277	1136
lb. Per Min.	3.78	4.16	4.14	4.00	4.03
Mean Idle Time	1.35	1.66	1.30	1.78	1.51
Cows Per Hour	10.9	10.0	10.8	.0.0	10.4 (30.1)

Afternoon Milking, 5/4/1967.

Machine Milking	77.63	79.15	78.86	64.69	300.33
No. Cows Milked	17	17	17	14	65
Total Milking Time	98.51	98.56	104.01	95.10*	396.18
Machine Idle	20.88(21.2%)	19.41(19.7%)	25.15(24.1%)	30.41(31.2%)	95.85(24.2%)
Mean Milking Time	4.6	4.7	4.6	4.6	4.6
Total Milk Yield	296(15 cows)	255	301	284	1136
lb. Per Min.	4.4	3.2	3.8	4.4	3.9
Mean Idle Time	1.31	1.21	1.57	2.34	1.57
Cows Per Hour	10.4	10.3	9.80	8.88	9.8 (39.4)

* Idle for 2 dry cows.